Yellowstone Science

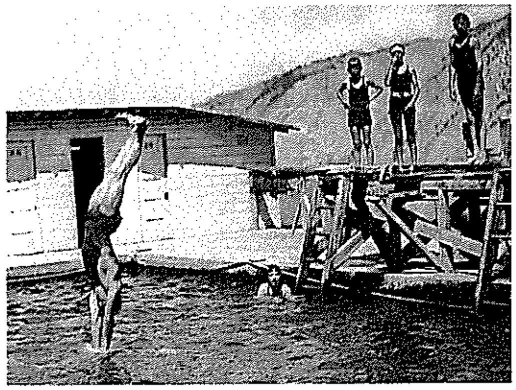
A quarterly publication devoted to the natural and cultural resources

The History of NPS Science and Management

The Absaroka Volcanic Province

The Fastest Falcon

Volume 6 Number 2



Scenes from the "visitors pleasuring ground." NPS photo archives.

Rhetoric or Reality?

It's always interesting for an insider to hear someone else, someone like historian Dick Sellars, comment about how Yellowstone appears from a distance of time, space, or in this case both. As he talked with *Yellowstone Science* about his documentary history of National Park Service science and resource management, I had a sense that some things had changed very little, in public and bureaucratic attitudes. Our fundamental values as an agency and nation still strongly lean toward just what the title of Sellars' book implies: *preserving nature in the national parks*...a fairly static condition in which if all *looks* well, perhaps it is enough to satisfy our constituents, the American landowners, and park visitors from other lands.

Those of us prone to such contemplations wonder about the popular image of our parks and the friendly park rangers, which usually rank high if not atop the list of public agencies and their servants. It's the decripit roads and facilities that serve the public which have garnered the most public and political attention in the past two decades, not any apparent lack of research and scientific decision making. If parks are clean and rangers are smiling, can the resources really be in danger of irreparable decay or extinction?

Interesting, as well, is park ranger Brian Suderman's read of Sellars' history. His only criticism focuses on Sellars' failure to credit rangers with a stronger role in preserving resources through their primary assigned duties of law enforcement, visitor contact, and interpretation. Webster says to preserve is "to guard, to keep safe from injury, harm, or destruction; to keep up and reserve for personal or special use..." Certainly the park rangers of our history and present do so.

But it is common for the scientists and professional resource managers in the NPS to say that we are a long way from understanding and embracing science in our mission and our daily work. Is this rhetoric or reality? Voices in and outside the Service are sometimes accused of "crying wolf" about declining biodiversity or threats to cultural resources and the need for more money, staff, and time to manage such threats. Are scientists their own worst critics in decrying the state of their ranks and programs? Is it a matter of different perceptions—even between park rangers and researchers—of what it means to conserve park resources? Or have scientists failed to convincingly explain, to the public as well as to other NPS employees, the seriousness of resource threats and just what future improvement are needed to achieve "scientific" resource management?

Such questions come more easily than answers...so we continue to present features on research and preservation activities in Yellowstone, hoping to spread knowledge and provoke some thought among readers about what it means to preserve nature and culture in Yellowstone.

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Yellowstone Science

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On the cover: A photo of a peregrine falcon in flight. Photo courtesy Tom Maechtle. Above: a group of young peregrine falcons in a hacking box before release into Yellowstone National Park. Photo courtesy Bob Oakleaf. See related story on page 16.

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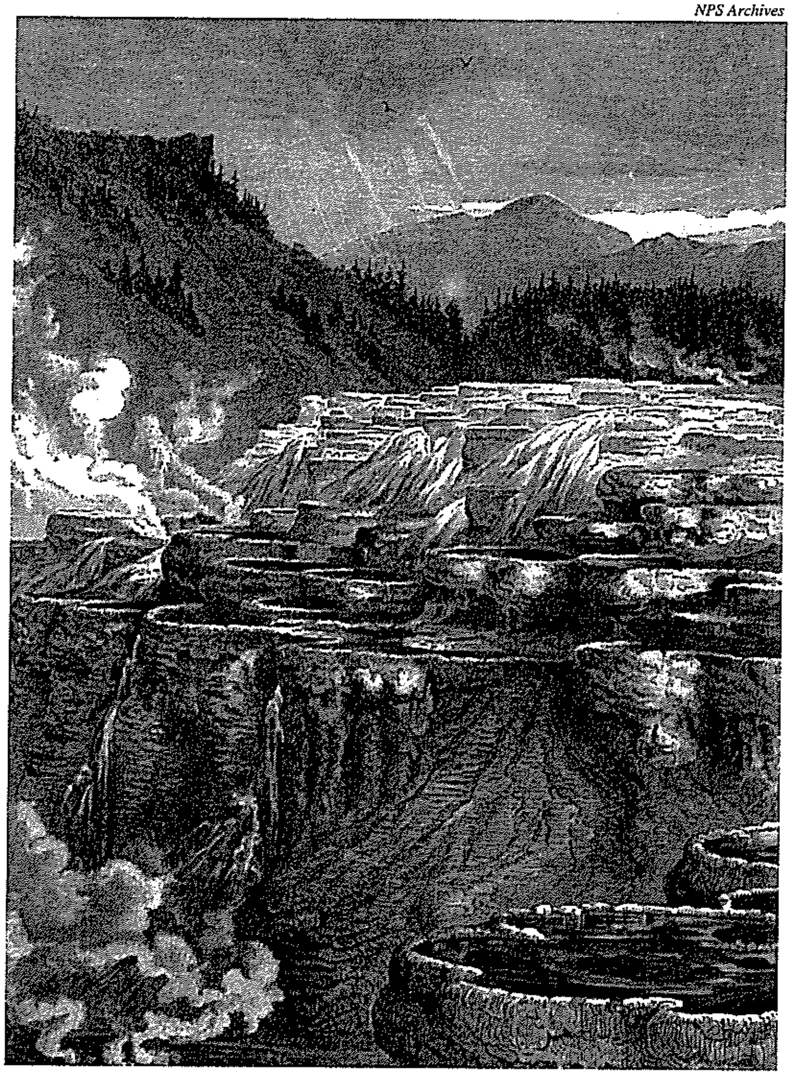


The Geologic History of the Absaroka Volcanic Province

By Margaret M. Hiza

Yellowstone National Park was established 125 years ago, primarily because unique geologic features of the Yellowstone region are among the world's greatest treasures. The high plateau rimmed by mountains, the world's largest geyser field, and the altered yellow rocks of the Grand Canyon of the Yellowstone are but a few features in the park which are the direct result of volcanic activity. Many readers are aware that part of the park is actually a large caldera that erupted violently only 600,000 years ago, in one of the largest eruptions known in recent geologic history; it may still erupt again. This young caldera also provides the heat source responsible for the largest geyser field in the world, and the numerous hot springs of the Yellowstone region. This heat comes from magma—molten rock below the surface.

However, volcanic activity is not new to the region; many of the rocks in the park formed from volcanism that occurred 50 million years earlier. This earlier eruptive activity produced another voluminous deposit of volcanic rocks, the Absaroka Volcanic Province. The province is the largest volcanic field of its age in the western United States, encompassing 9,000 mi² (23,000 km²) of the greater Yellowstone region and roughly one-third of Yellowstone National Park (Fig. 1). Volcanological and geochemical features within these older volcanic deposits are not only unique to the region, but to the world.

The Absaroka Volcanic Province was a region of interest for early prospectors who mined gold and silver associated with old volcanic centers. It is a region famous to geologists for the first recognition and naming of the absarokite-shoshonite-banakite series. This is a group of highly potassic volcanic rocks, first found and described in Yellowstone by Joseph Paxton Iddings in 1895. Also uniquely preserved within the Absaroka province are nearly the entire volcanic edifices of large stratovolcanoes together with proximal and distal volcanic deposits, well exposed in a terrain dissected by glaciers. These ancient volcanoes are similar in form to Mt. Rainier, Mt. Fuji, Mt. Kilimanjaro, and other modern stratovolcanoes, but because they are old and inactive, yet well-preserved with canyons cut through them by glacial activity, they afford geologists a unique opportunity to study the inner plumbing system of volcanoes (Figs. 2 and 3). Many of the exposed features of these stratovolcanoes were described during the Hayden Survey of the early 1870s. They were studied in detail by Thomas Jaggar and J.P. Iddings during a subsequent expedi-

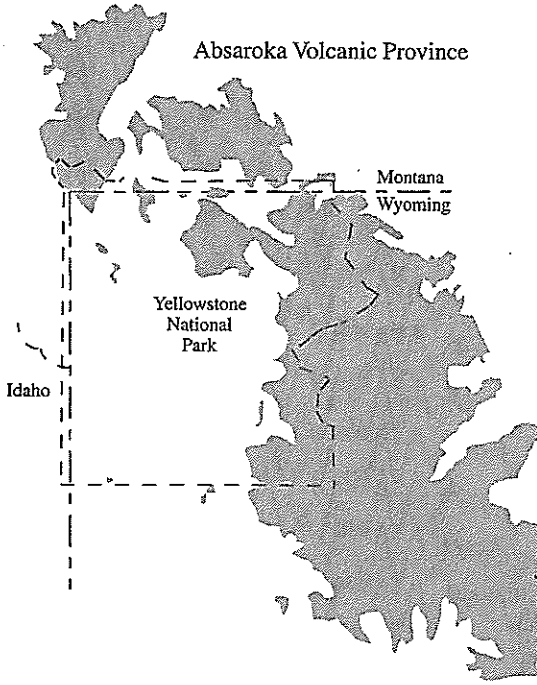
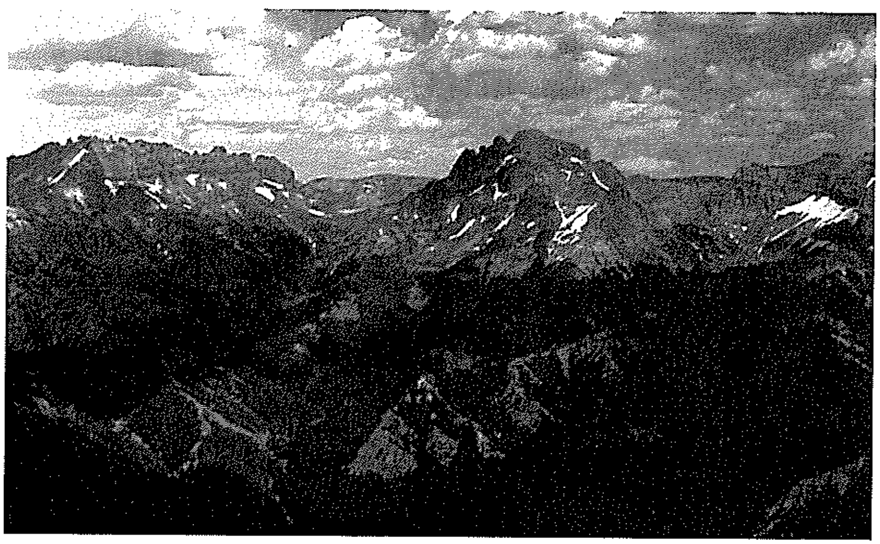
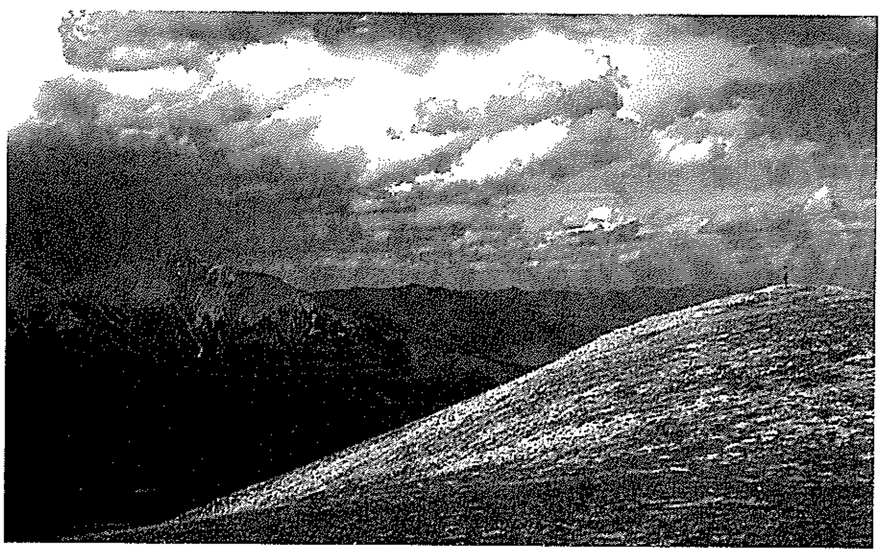


Figure 1. Map showing the distribution of volcanic rocks of the Absaroka Province in the greater Yellowstone region.

Figure 2. Photo of Rampart volcano east of Trident plateau showing remnant dipping lava flows on either side of volcanic edifice. Canyons which dissect the volcano are the result of glaciation.

Figure 3. Photo of Electric Peak as seen from the summit of Greys Peak in northern Yellowstone Park. Electric Peak is a portion of a volcanic edifice-related flow on Sepulcher Mountain. These formed during early volcanic activity in the Absaroka Volcanic Province. All photos courtesy Margaret Hiza.





tion by Alexander Hague and are the origin for volcanological terms now used the world over.

One example is the "laccolith" of Mount Holmes, which is the first of its kind ever described (Fig. 4). Preserved within these volcanic deposits is a world-class continental faunal assemblage, including early primate species found nowhere else on the planet. Entire ancient forests from a period of earth's history which was one of the warmest known are also fossilized within the large volumes of ash and coarse sediment. These deposits record a period of dramatic climate change to the cooler temperatures we experience today. How long this warm period lasted, and how quickly it changed, is not known precisely but may become clearer as the age of the volcanic deposits become better known.

Mapping and Dating Old Rocks

Since the late 1800s, the rugged and remote nature of the region has restricted geologic research to a limited number of studies that are still done by scientists traversing the park on horseback and on foot, as in the days of the Hayden Survey (Fig. 5). I began studying volcanic rocks of the Absaroka Volcanic Province in the greater Yellowstone region in 1990, as a graduate student at Montana State University. My early studies focussed on the sedimentary sequences, which were formed by similar processes as those witnessed by many geologists during the well-known eruption of Mt. St. Helens in 1980. After this event, volcanologists began to study the sedimentary record more carefully because of a new awareness of the dangers imposed by large volumes of sediment that are produced during volcanic activity. As my thesis study continued, I became increasingly aware of how little was known about the Absaroka Volcanic Province as a whole, even though it is located in an area famous for its geologic features.

Because so few studies had been done, it was impossible for me to assign an absolute age to the deposits I had been working on, or to compare them to rocks of the same age in other parts of the province. General age relationships between groups of rocks in the Absaroka

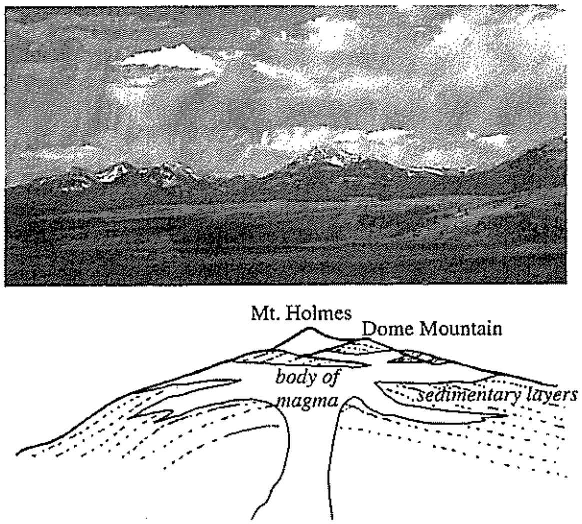


Figure 4. Sketch and photo of Mount Holmes, illustrating the features of a laccolith, which consists of sedimentary layers pushed upward by an invading body of magma.

Volcanic Province had been published in 1972 by Smedes and Protska. Although this work was an excellent preliminary study, it was based on only 14 isotopic dates, 10 of which were derived from rock samples along the southern margin of the province from only two sample localities. Only two samples within Yellowstone Park had been dated, and none of the rocks on which my study focussed had any age assigned to them. Even more astounding is the fact that the Absaroka Volcanic Province has never been completely mapped in detail. Only general maps based primarily on aerial photographs exist for much of the province today.

Much of this region has remained unstudied because of the rugged, mountainous nature of the Absaroka Volcanic Province, which encompasses the largest portion of roadless area in the conterminous United States, including portions of four wilderness areas, four national forests, and the eastern third of Yellowstone National Park. With the exception of the study by Smedes and Protska, the only other study of the entire province was conducted under the supervision of Hague in the late 1800s. Unfortunately, most of this early work was never published.

Geologists have long been puzzled as to what caused volcanism to occur 50 million years ago in the greater Yellowstone region, producing the Absaroka Volcanic Province 1,500-km inland from the margin of the North American plate. Through my study of this enigmatic volcanic field, I address fundamental questions about why magma erupts and where and why melting occurs during volcanic activity. To answer these questions, detailed mapping and sampling of major volcanic centers for detailed geochemical analyses is necessary. These analyses can be used to constrain models of melting based on our current knowledge of the chemical constituents of the earth's crust and mantle. These models are then used to located magma sources.

Another important aspect of my study is a basic understanding of the volcanic province—the sequence of eruptive activity, which I present here. This new work includes significant revisions to age relationships proposed by the earlier work of Smedes and Protska, produced by utilizing more precise modern dating techniques. K/Ar isotopic dating in previous work is based on measurement of ^{40}K (potassium), which decays to ^{40}Ar (argon) with time. This dating method requires very precise measurement of the absolute abundances of K and Ar found within K-bearing minerals in volcanic rock. An alternative technique is to irradiate the sample and thereby convert ^{39}K to another isotope, ^{39}Ar. This is the innovation of the ^{40}Ar/^{39}Ar method, which is more precise and accurate because it relies on proportions rather than absolute abundances. Isotopic dates produced by ^{40}Ar/^{39}Ar, used in this study, are combined with geologic mapping and published paleomagnetic data to piece together the sequence of volcanic eruptions that took place in Yellowstone Park.

The sequence of eruptive activity includes the eruption of ash-flow and fall deposits. These deposits result from large, explosive events that produce an eruption column and plume (Fig. 6). Pyroclastic flows also result from explosive eruptions, but move downhill across low-lying areas. These flows, as well as the eruption column, contain hot volcanic ash, pumice, and other rock fragments. However, deposits from an eruption column are different, because as the eruption column collapses it forms a blanket of ash and pumice across a broad region, instantaneously. New data on the age of these deposits permit their use as regional stratigraphic markers, which constrain the stratigraphy and history of geologic events within Yellowstone. Improved dating permits correlation of three widespread ash-flow tuffs, and has led to a new appreciation of the catastrophic nature of volcanism in the Absaroka Province. Because the three ash-flow tuff eruptions took place within a short period of time (geologically speaking) with many volcanic deposits between them, the age data has also illuminated how voluminous eruptive activity took place during a brief period.

Figure 5. Photo of author conducting fieldwork in the same historical fashion as earlier studies within the northern Absaroka Volcanic Province.

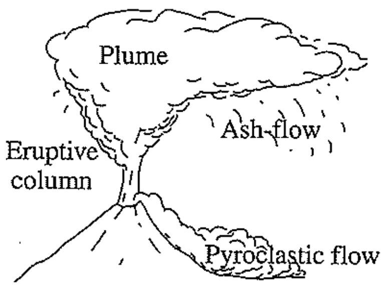


Figure 6. Sketch showing eruption column, plume, and pyroclastic flow.

"New Age" Volcanics

Eruptive activity of the Absaroka Volcanic Province began 53 million years ago (Ma) during a period of crustal extension, first recorded by movement along the South Fork detachment fault, which cuts the Eocene Willwood Formation. The Willwood Formation is a deposit that lies below the Absaroka volcanics, which are of similar age. At about the same time, smaller, scattered volcanic fields began to erupt in a broad belt extending from Oregon and Washington to the Black Hills of South Dakota. From the onset, eruption in the Absaroka Volcanic Province was highly explosive. Dacitic pyroclastic flows of hot, flowing volcanic debris erupted from small, localized volcanic domes in northwest Yellowstone and produced ash-flow tuff and pumice-fall deposits. These oldest known deposits are at the base of Sepulcher Mountain. Previously mapped as Lost Creek Tuff, an $^{40}Ar/^{39}Ar$ eruption age of 53.0 Ma indicates that these tuff deposits are four million years older than earlier estimates. This early event was followed by eruption of rhyolite ash-fall from the South Fork volcanic center, which can be seen on the South Fork of the Shoshone River. This eruption blanketed the Wind River Range south of Yellowstone with ash.

Then, during a period of only two million years, eruption took place over a broad region, encompassing the entire province and producing most of the Absaroka Volcanic Province deposits found in Yellowstone Park today. It began 49.5 million years ago with the eruption of Slough Creek Tuff. Erosional remnants of this ash-flow tuff are thick and extensive, and cover a large part of the area which is now the southern Beartooth Mountains and northern Yellowstone. It resulted from a large-scale explosive eruption that produced volumes of ash which covered an even larger area in the past. Preserved outcrops in the southern Beartooth Mountains are several hundred feet thick. In Yellowstone, the tuff is most visible west of Slough Creek, where it appears as a deposit with distinctive light and dark bands which can be seen when hiking along the Slough Creek trail. When the ash was deposited, some of it was hot enough to melt back together, becoming welded. The welded portion of the Slough Creek Tuff is black volcanic glass overlain by very light-colored non-welded ash, which gives this deposit its striped appearance.

Lava flows on Sepulcher Mountain, Crescent Hill, Buffalo Plateau, and Elk Creek erupted from fissures following the eruption of Slough Creek Tuff. Pryoclastic flows are also characteristic of this eruptive period. Much of this debris was remobilized by water into volcanic debris flows, commonly called lahars. This kind of mobilization typically results from deposition of large volumes of fragmented material (mostly volcanic ash) on steep slopes, which kills plant life and chokes stream channels. Volcanically induced rainfall, in addition to ash-filled river water, act to remobilize volcanic debris into sediment-water mixtures which resemble rapidly flowing concrete.

Deposits similar to those in the Absaroka Volcanic Province have been produced during recent volcanic eruptions such as the 1991 eruption of Mt. Pinatubo in the Phillipines, where millions of cubic tons of debris were redistributed by lahars in only a few years following the eruption. In Yellowstone, deposition of lahar and streamflow deposits produced the Sepulcher and Lamar River formations, which are thick, coarse-grained deposits containing numerous upright fossilized trees. These deposits can be seen in the Lamar Valley surrounding the Lamar Ranger Station, along Icebox Canyon, on Sepulcher Mountain, and on Bighorn Peak. Eruptions from vents located in the Two Ocean Plateau area of southern Yellowstone also began about 50 million years ago, but most of the early deposits in this area were eroded away.

Marking Time

A second large ash-flow eruption occurred 48.8 million years ago, depositing the Lost Creek Tuff and Pacific Creek Tuff. Although mapped separately in the past, they are now correlated based on $^{40}Ar/^{39}Ar$ ages and shared geochemical composition. Products of this second large ash-forming eruption can be found across a broad region, from the Hellroaring trailhead and Floating Island Lake in the north to Two Ocean Pass at the southernmost margin of Yellowstone National Park—and beyond park boundaries. Deposits from large ash flows such as this one are important in determining stratigraphic relations and geologic history, because they are widespread and produced from an instantaneous event. They represent a time line or marker bed which allows correlation of volcanic deposits above and below them. Geologists can use the age of two or more of these deposits to estimate the volume of material erupted during a given period of time. Immediately above and below this ash-flow deposit, and correlated by its presence, are large volumes of fissure-fed lava flows that erupted near Sylvan Pass and the Mirror Plateau in eastern Yellowstone. Also correlated with this ash-flow deposit, where it is found in southern Yellowstone, are lava flows, pyroclastic flows, and lahar deposits of the Langford Formation. A period of broad uplift followed, producing widespread tilting and erosion, exemplified by the erosional unconformity at the top of the Langford Formation in southern Yellowstone. Deposits of the Langford Formation, ash-flow tuff deposits, and this well-developed unconformity can be seen along Pacific Creek, Two Ocean Creek, and from the Two Ocean Plateau trail.

Tracing the Tectonic Story

An ash-fall deposit in the Two Ocean Formation, now correlated with the Blue Point ash-fall in the greater Yellowstone region, erupted 47.5 million years ago

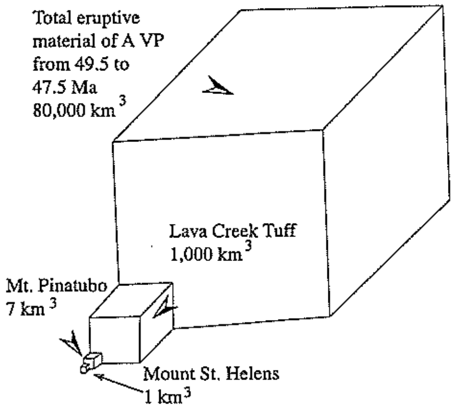


Figure 7. Volumetric comparison of ash-flow tuff produced by recent eruptions and total eruptive products from the Absaroka Volcanic Province, including the Yellowstone caldera eruption of Lava Creek Tuff which took place 600,000 years ago (modified after McBirney, 1979).

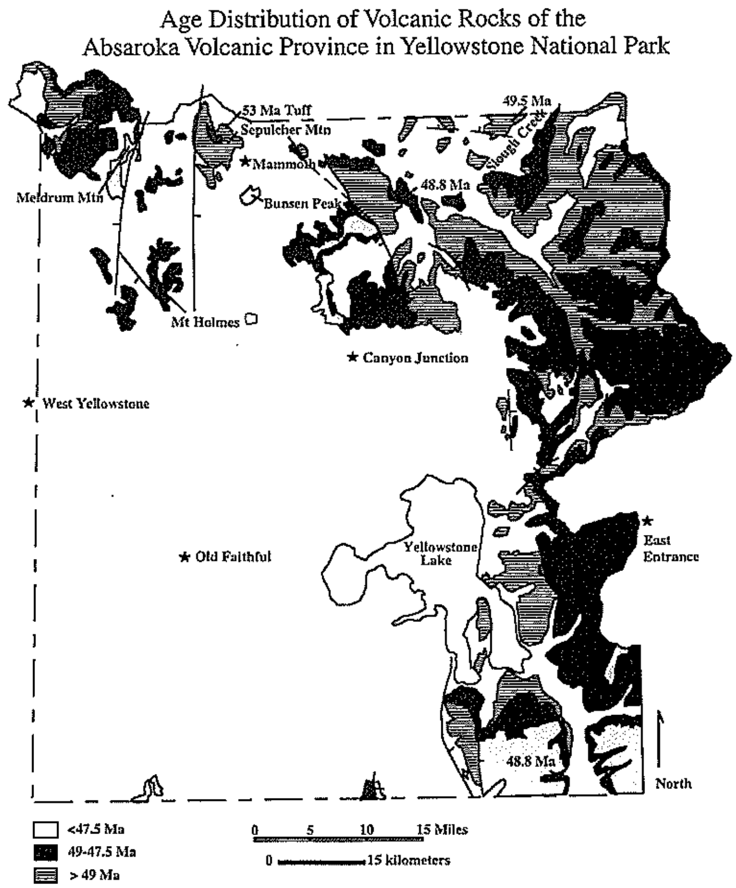


Figure 8. Map of Absaroka volcanic rocks in Yellowstone Park showing age relations based on recent stratigraphic correlations.

and marks the end of widespread Absaroka volcanic activity in the park (Fig. 7). It is preserved on Two Ocean and Trident plateaus and can still be seen from the trail along Thorofare Creek. This same deposit can be seen outside Yellowstone, as light-colored layers of volcanic ash on Ramshorn Peak, on the north side of Highway 287 between Jackson and Dubois, Wyoming.

Estimating the volume of material erupted during the Absaroka period is not easy, because what remains today is an erosional remnant of what was originally produced. Any estimate must be based on where we see remaining deposits belonging to the Absaroka Province, and assuming that the area between these also contained material produced by this episode of eruptive activity. It is highly unlikely that the entire area now occupied by the younger Yellowstone caldera (c.a. 0.6 Ma to 0.06 Ma) once contained volcanic rocks of the Absaroka episode, because the earlier volcanic rocks surround the caldera today. During the two-million-year period between the eruption of Slough Creek Tuff, which occurred 49.5 million years ago, and the Blue Point ash-fall, nearly all of the Absaroka Province volcanism within Yellowstone was complete, and probably more than 80,000 km^3 of volcanic material had erupted (Fig. 7). In northern Yellowstone, the last eruptions produced volcanic domes of silicic lava (dacite to rhyolite composition), such as Bunsen Peak and Meldrum Mountain (Fig. 8). Silicic lavas such as these are very viscous and do not flow very far, producing these thick deposits.

Most of the younger Absaroka volcanic deposits in Yellowstone are limited to pumice, ash-fall, and light-colored rhyolite flows on Two Ocean and Trident plateaus, which are interbedded with deposits from lahars. These deposits are typical of the last period of volcanic activity, which ended with the eruption of Dunrud Peak rhyolite southeast of the park 43.7 million years ago. Although some of the youngest deposits in southern Yellowstone have not been dated, future work may allow them to be correlated with volcanic deposits in the surrounding region (Fig. 9).

With continued research, lava flows and ash-falls will be traced to individual volcanoes within the Absaroka Volcanic Province. As the history of the volcanic field is pieced together, so is the tectonic history of North America. The age data from this study is combined with chemical analyses of major and trace elements and of isotopes of Nd (neodymium), Sr (strontium), and Pb (lead) from the volcanic rocks. This data is used to determine how and where the magma that erupted in the Absaroka Volcanic Province first formed, and why eruptions occurred within the North American Plate during this period. New stratigraphic information from my study can also be used in the study of important fossil assemblages, and to document a period of dramatic change in Earth's history. Understanding how the Earth's climate has changed, and its volcanic behavior in the past, enables us to better predict these types of behavior in the future.

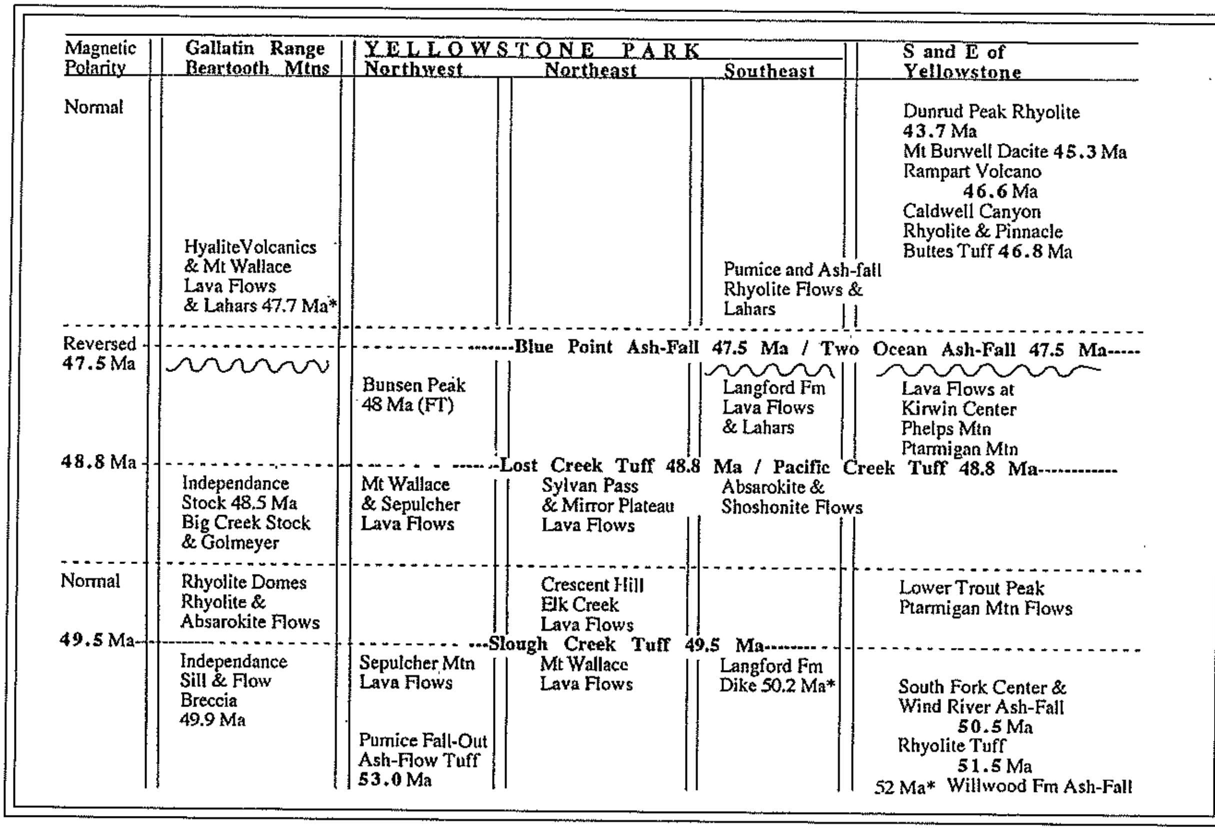


Figure 9. Stratigraphic relations of volcanic rocks within the Absaroka Province, with locations of rock types and formations subdivided within Yellowstone Park and surrounding areas.

Table 1. Types of volcanic rocks found in the Absaroka Province.

Rock Type	Occurrence	Color	Minerals
Absarokite	Flows from prominent dark cliffs	Black/dark grey	Olivene/pyroxene
Shoshonite		Dark grey	Pyroxene
Banakite		Grey	Olivine/plagioclase/ biotite
Dacite	Thick flows form knobs, or in explosive eruptions of ash-flow tuffs	Light grey/tan	Plagioclase/ hornblende/biotite
Ryodacite		Tan/orange/pink	Sanidine/biotite/quartz
Rhyolite		Tan/orange/pink	Sanidine/biotite/quartz

Margaret Hiza is presently a graduate student in the department of Geosciences at Oregon State University. Her Ph.D. research on the Absaroka Volcanic Province has been funded by the U.S. Geologic Survey as an internship with the National Cooperative Mapping Division in Denver, Colorado. She began working in the province while working on her M.S. in Earth Science at Montana State University in 1990, under a National Science Foundation Fellowship. Her research has also been funded by grants from GSA, AAPG, Sigma Xi, The Colorado Scientific Society Pierce Memorial Fellowship, and the J.D. Love Fellowship. She plans to graduate this year and hopes to continue geologic research related to geochemistry and volcanism within the Yellowstone region.

Suggested Reading

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Yellowstone Science Interview: Richard West Sellars

The Evolution of NPS Science and Natural Resource Management

Rhetoric versus Reality

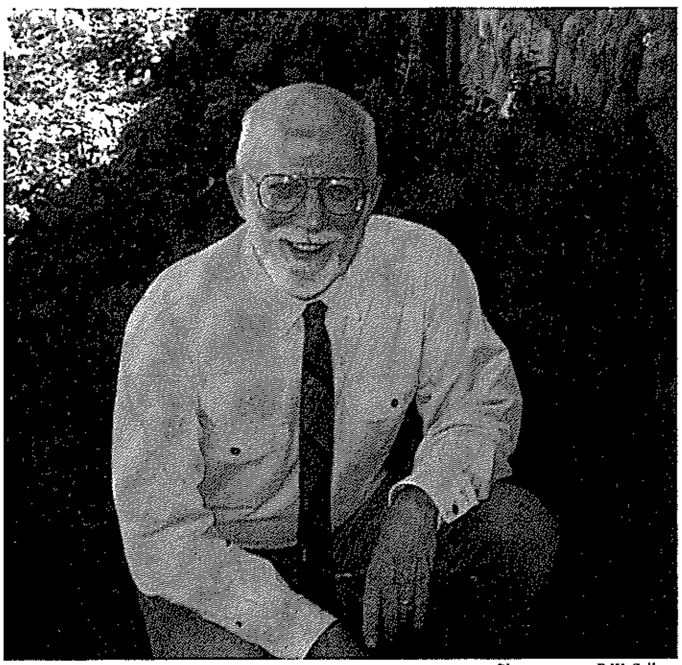

Photo courtesy R.W. Sellars

Richard West Sellars is a Texas native who studied geology at Baylor University and has a Doctorate from the University of Missouri at Columbia. He worked for the National Park Service (NPS) first as a seasonal ranger in Grand Teton National Park, then with the Denver Service Center. He got a permanent position with the regional office in Santa Fe, New Mexico, thinking, he said, "that I wouldn't be there very long—that was in 1973—and I'm still there!" He is the author of Preserving Nature in the National Parks *(Yale Univ. Press, 1997), a study of natural resource management in the NPS. After speaking at the October 1997 conference on* People and Place: the Human Experience in Greater Yellowstone, *Dr. Sellars had this conversation with the current editor and Paul Schullery, historian and former editor of Yellowstone Science, about his research.*

YS: How did you get interested in history, specifically in writing a history of resource management in the National Park Service?

RS: For the first 15 years of my career, I was involved with historic preservation. But I have some background in environmental history; in fact what happened was that after Alston Chase's book, *Playing God in Yellowstone*, came out, the Park Service decided it had better look at its own history. The Washington Office began preparing a history of natural resource management in the National Park System to be researched and written in four months.

That was 1987. I thought it was a very bad thing for the Service to try to do that in four months—it would be shot down immediately. Then I asked for the assignment on a longer range basis, and I got it.

YS: Thus the publishing of *Preserving Nature in the National Parks*. What types of research did you use to write the book. Did it include actually interviewing people, or was it all done from the documentary record?

RS: I spent about the first 15 months doing background reading and documentary research. My wife, who is the research librarian at the Museum of International Folk Art in Santa Fe, took leave of absence from her job and traveled as a volunteer with me for the better part of a year doing research around the country: National Archives, NPS Harpers Ferry archives, the Bancroft Library, the Museum of Vertebrate Zoology at Berkeley, a number of parks, and a few other collections.

I did quite a number of interviews, but as it turned out I didn't use a lot of them. For one thing, I had to be opportunistic with the interviews and do them when I had a chance to visit with people, and that was mainly in the very first part of the project when I was not that familiar with the questions I needed to ask. Thus I was not always asking the questions that I would want to know about later. Secondly, I really found out more than ever before that oral history has its problems. People want to remember things in a certain way. Sometimes they are absolutely correct. You're giving me a little oral history right now [laughs]. But the documents are so much better. If you're talking to someone about the early 1960s or the early 1970s, not only has it been a number of years since that time, but they might not really remember it all that well because today they just see things in a different way. So I used the documents far more than oral history. The real benefit of the interviews was to get me more familiar with the subject matter, and with the questions being raised and the concerns that people had.

During the early days of aggressive predator control this photo shows five men posing with wolf carcass at the Soda Butte Soldier Station in 1905. Photo courtesy NPS Archives (YELL 36953).

YS: What were the questions you most wanted to answer?

RS: I realized from the very first that I was not going to do simply a history where "this research project was done and that research project was done" and where "so many scientists were hired at this time and so many at that time." This was an administrative history of natural resource management; that's what the official definition of this book has been all along. But I would never give it that title—I want it to sell more than a dozen copies! I realized that I was going to have to look at natural resources management not by itself, but in the context of what else the National Park Service was doing, asking the question that, if the Service was not conducting natural resource management in tune with the ecological knowledge of the time, what was it doing instead, and why? What were its priorities, and where did natural resource management—in particular, scientific natural resource management—fit in?

That's the reason the book deals quite a bit with what I refer to in the introduction as *de facto* natural resource management, which is to say intensive development in certain areas such as along the South Rim of the Grand Canyon, which altered the natural systems in that area considerably. Or in the Yosemite Valley. I looked at development as an impact on natural resources and thus as a way of managing them out of existence, or certainly altering them considerably—and setting up conditions with which later natural resource managers and scientists and superintendents would have to contend.

So, I was looking both at development and at what we refer to as natural resource management—the actual, direct, hands-on approach to natural resources—trees, and mammals, and whatever. The book deals quite a bit with the developmental impulses of the Park Service.

YS: You mention that people perhaps didn't even remember correctly to the 1960s and 1970s. Did you go back to whatever beginning documentation you could find for resource management?

RS: I go back to the 1870s and I deal with natural resource management in the nineteenth century as practiced by Army and civilian superintendents and their staffs, on up through the time the Park Service was established. The book begins with Yellowstone in 1872, which I consider hands down to be the first national park. It's odd that some people argue that Yosemite was the first national park, but in 1864 the federal government divested itself of the responsibility to run that area. I see the Yellowstone act as a much more broadly developed statement of national park philosophy and policy. I think of those who argue that Yosemite is the first park and then talk about the campfire story and the creation myth in 1870. Wait a minute. It doesn't make sense. Yellowstone is clearly the first national park, so I began with Yellowstone.

YS: I'm surprised how often I hear a sort of retroactive judgmentalism. We are wandering back through our history and we unavoidably pass a lot of judgments on when "they" were right or wrong. In some cases, like the mistreatment of Indians, we exercise a lot of outrage too. But in other cases, like decisions about natural resource management, we tend to have a smugness about how "we know so much better now." And there's a hardness to the judgments that I think is inappropriate. What I'm getting at is this process by which more and more of us have come to recognize that science is just absolutely essential for all our decisions.

But some superintendent in Yellowstone in the 1920s could, intellectually, with a certain amount of integrity even, very comfortably feel differently about it and see the scientific crowd who were lobbying him to stop killing predators as another special interest group: "I've got the Cody Chamber of Commerce hammering me about this; I've got the Northern Pacific Railroad bribing my Congressman about this, and I've got these *scientists*, you know..." And that superintendent, because of the way his mandate had shaped up accidentally (sometimes purposely), it wasn't intuitive to him that science should be his primary guide. It was almost a social victory for the scientific community that it worked out that way. Now, we see that all with hindsight. I'm troubled when I see historians sort of perverting that hindsight and implying that that guy was stupid, or even that there was something sinister going on there. What I'm really interested in is how these people worked through what is essentially a value system, because their mandate was so muddy it wasn't going to tell them.

RS: I think that it's important to consider the National Park Service Act and who its principal founders were: a borax mining executive, retired (Stephen Mather); a landscape architect (Frederick Law Olmsted, Jr.); a horticulturalist (J. Horace McFarland); and a young lawyer (Horace Albright). None of them had biological training to speak of beyond horticulture. It seems pretty clear to me from their correspondence that they were looking at preserving the dignity and majesty of national park scenery, including wildlife, and that they were looking at this in gross terms rather than with the precision of a biologist.

Their ideas tied into public enjoyment

very closely, which is mentioned at least twice in the NPS' act's principal statement of purpose. They were very concerned about that and about keeping the parks attractive to the people. That was one reason they would fight fires; it's one reason that they would kill predators to save the favored mammals. I think that it is important to note also that the 1916 act did not mandate new management policies. The Service merely continued with policies used by its predecessors, the early superintendents of the parks civilian and military. I do not believe that the Organic Act changed the policies whatsoever as far as day-to-day management of the parks went. I see the superintendents as doing a job that they thought was right and proper, and they reinforced that in kind of a group way, among themselves.

So, when the scientists came into the Service, about the very late 1920s but mainly the 1930s, they were truly insurgents. They had a different point of view. By contrast, the superintendents of the 1920s were mainly engineers; they were out of the developmental professions and they had the developmental impulse. They knew that if the national parks weren't developed for tourism the whole idea was likely to be lost, and the U.S. Forest Service might gain control of the parks.

YS: Let's move to the late 1950s, when a bunch of things are about to happen soon but they haven't yet. A superintendent in any big natural area right then—what might make him see those special interest groups differently?

RS: Many of the values espoused by Mather and Albright and their followers and associates in the 1920s were still in place in the Service by the late 1950s. The effort that George Wright [*the first NPS scientist, who in 1929 founded and funded out of his own pocket an NPS wildlife division*] and his fellow biologists had made to try to change the perspective had pretty much died out. There were still some very fine scientists in the Service, like Adolph Murie and Lowell Sumner. But as far as management itself goes, their perspective had not changed. The change came beginning really in the 1960s with the Leopold Report [*a 1963 review of wildlife management in the national parks that prompted a servicewide change in natural resource management policies*], and the National Academy Report [*a 1963 review of NPS science programs.*]

YS: But some of Wright's ideas had taken hold, such as restrictions on predator control.

RS: That is a good point. Changes had occurred, rather gradually. For example, Wright's group had pushed for reviewing and altering the fire policies. NPS biologist Adolph Murie was outspoken about that. There is a wonderful set of letters: a debate between Lawrence Cook, who was at that time chief forester for the national parks in the West, and Adolph Murie, about the McDonald Creek fire in Glacier National Park in about 1936 or 1937. It's an excellent debate; you can see the two different policies and philosophies working against one another —the traditional forestry policy that Cook espoused, and the more ecologically attuned policy that Adolph Murie espoused. But the Service rejected Murie's argument.

Superintendent Horace Albright in 1922 celebrating amongst the accoutrements that reflected the thinking of the day. NPS photo archives (YELL 37160).

And with the predator policy, Horace Albright, for decades even after he resigned from the NPS in 1933, remained determined to keep the parks' coyote populations down. There was plenty of support within the Service for killing coyotes—reflecting adherence to traditional ways—even after Albright himself had promulgated a more tolerant predator policy in 1931.

YS: The primary movement for the preservation of wilderness actually came out of the Forest Service. I never hear much about Park Service scientists or managers joining into that. Did I just miss it, or did the Park Service have this attitude that I think we still have today, that we don't need that extra piece of legislation because we're already protecting our parks?

RS: The answer to that question is that the Service did drag its feet on the Wilderness Act of 1964—it opposed it for a long time. But also within the Service there were men—Lowell Sumner, Adolph Murie, Victor Cahalane, for instance—who were very strong and early supporters of wilderness. But Murie, Sumner, and others who supported wilderness were not park leaders; they were biologists, and they were down in the ranks. Park leadership felt that the Service didn't need this overlay of wilderness regulations. Frankly, I believe, skipping ahead toward the present, that one reason some of the major parks still do not have designated wilderness is that it has never been a top priority in the NPS. Had it been so, had the Service and the superintendents been constantly working with their congressional delegations and their support groups and made it a very high priority for the past 33 years, I think we would have more wilderness in the system than we have today.

YS: Yellowstone is one of those big parks without designated wilderness. I suspect that a lot of people recognize that wilderness is probably a purer classification than the way we manage our backcountry. We hear that the staff need the freedom to go out with chain saws, or helicopters, or whatever it is they're going to do. It seems funny that it's our branch of the federal government doing what the public in the West does to us—saying, "we don't want those darned feds in here telling us how to manage!"

RS: It was the same way with the National Environmental Policy Act of 1969; we didn't want it. With the National Historic Preservation Act, we supported the passage, but we didn't want to mess with those regulations. The Wilderness Act was really the first of the environmental-era legislation whose implementation the NPS resisted.

YS: Isn't an examination of NPS culture

important to understanding our history?
RS: What really happened, I think, is the establishment in the 1920s under Mather of a dominant Park Service philosophy, a culture that valued managing parks for scenery protection and for public enjoyment. As long as the forests were green, as long as there were elk grazing and a fair number of visitors could see them, it didn't really matter too much whether there was a high elk population count or a low count. This reflected a fundamental set of values that the scientists would soon challenge. The scientists faced a unified perspective among Park Service leaders—who were geographically spread out but philosophically unified—favoring scenery and tourism management. And scientific knowledge was not a necessary part of that. In fact, science challenged that perspective.

George Wright and the biologists of the 1930s were effectively saying "you're not running these parks correctly; you're not doing the right thing. And these are the reasons why." That was a challenge—even though the Service was only 12 to 14 years old—to already established traditions. The scientists were telling managers that they were not handling their resources properly.

My next research project is a history of historic site management. And in contrast to the scientists, historians and archeologists and architects who emerged in the Service in the 1930s—about the same time that the wildlife biologists were emerging—did not run into the same kind of organizational barriers in seeking to gain influence. And the reason, I think, is that they were operating in a different world—working in the archeological parks in the Southwest and the patriotic sites in the East. They were not telling the mainline, mainstream Park Service management that they were managing the parks wrong. So by comparison they had an easier time of it, whereas the biologists were really insurgents; they were challenging tradition.

Not only traditional ways of doing things, but if you were an individual who had been hired as a ranger in 1919 and you made it to a superintendency in 1925, you gained status in part because you thought the way the leadership did. You were drawn into the culture, through a kind of filtration system. You succeeded because you agreed with what leadership believed. The scientists, by contrast, were challenging the system. And so what happened to the scientists? You don't see them rising up in the ranks. Carl Russell became head of Yosemite, he was an exception; he had a Ph.D. in wildlife biology, I think from Michigan. But by and large the scientists were kept out of upper level management. And they were marginalized because they challenged values that were already established under Mather and that had roots in the nineteenth and early twentieth centuries before the NPS.
YS: When you said that scientists went against mainstream management, are we talking about the big traditional parks, the Yellowstones and the Yosemites?
RS: By and large. That's where the natural resource issues were played out. Yellowstone, Yosemite, and later, Everglades and the Great Smokies, for example.
YS: It goes back to the scenic and tourism values; there was already perhaps a very strong economic constituency.
RS: Yes, for scenery and tourism management. But the scientists were not into that, particularly. Although I think they firmly believed that scientific natural resource management was compatible with tourism, that it should be a matter of good clear thinking and investigation about park development and management.
YS: Can we talk specifically about Yellowstone? Not just because it's the first park and we're here but because I think it's still portrayed as having been the first for so many other things in the Park Service. For example, the Leopold Report itself—one of the things that led to it was the elk reduction here.
RS: That was the principal concern that led to the report.
YS: I'm interested in your documentation of how Yellowstone reflected trends in the Park Service. We certainly still get criticized—I think very much—for our lack of use of science in resource management, and all that may be legitimate. We don't hear much about how Yellowstone is viewed as either a good or bad example of resource management or of using science to afford better decisions. I have no way from "the inside" of knowing how historians view [our park] from a more objective perspective.
RS: In the book, I use Yellowstone more than any other single park because I think it really was a trend setter in natural resource management. Also, it is the one park that continually draws public attention, although others do, at times. But not to exclude the influence of other parks: for instance, fire management policy changes emerging in Everglades in the 1950s when Bill Robinson began to experiment with prescribed burning. Similar efforts began a bit later in Sequoia. Fish management policies began to change pretty much throughout the System, a little in the 1930s and some more in the 1950s. So you have these things interacting around the System; and yet on the whole Yellowstone is probably the one park where natural resource management is always at least visible, and often at the forefront of public interest.
YS: Being put in that role so often and getting so much attention appears to generate tremendous resentment and jealousy in the culture of the Park Service. I've seen some just bitter stuff against Yellowstone—vengeful stuff; I've actually witnessed it. I'm curious if you've picked up on that.
RS: Honestly I haven't. I've heard some of that myself, not much of it, but I didn't come across it in the documentation. I don't doubt its existence, though.
YS: There's a legend about Horace Albright walking into an office somewhere—it's famous Park Service folklore—and somebody had put up a sign that said "that's the way we've always done it in Yellowstone." Apparently Horace was really annoyed. When I first came here I heard that [*park superintendent from 1967 to 1975*] Jack Anderson had the sign over his door and told his chiefs, "Don't give me that excuse!" [laughter]. That's the image of Yellowstone as this place that's unwilling to change, as opposed to a Yellowstone that gets stuck being the guinea pig all the time.
RS: What attracts me to Yellowstone is not just its scenery and the wonderful things there are to see here, and the natural resources, but also its history. And that's most readily exemplified in the buildings. Certainly the Old Faithful Inn

is a premier example of that. You immediately get a sense of the early national park years in some places in Yellowstone, and it gives it a depth, that while Yosemite, for instance, has some of, it's not as evident as it is here. Yellowstone is a fascinating, complex place historically and from a point of view of natural history as well. The historical factors might not be the reason most visitors come here, but I think it enriches their experience.

YS: On the other hand, that's complicated the mission. Now there is a vast outdoor museum of huge, expensive objects that we're saving, which changes the priorities of budgets and everything else, a lot.

RS: Such changes are expressions of the public will, as stated in the 1966 National Historic Preservation Act, which is an expression of concern about historic features in a big natural area like this. It's as much law, as strong a mandate, as for the preservation of natural resources.

YS: Without asking you to finger personalities, in your research did you find a clear correlation between who was superintendent and his attitude toward science or resource management? Is it largely personality driven, either by the presence of a very strong scientist or manager?

RS: I think we have had a number of superintendents who have proved very supportive of scientific resource management in the parks. The problem is that it depends upon the individual superintendents; it's not a pervasive Servicewide attitude that we must have scientifically informed and intelligent management. And in the age of ecology we now know that the only way to have intelligent management is to have ecological knowledge. We speak about this a good bit, but we don't necessarily do it.

You mentioned personalities. I would have to say the book provides an especially revisionist view of Horace Albright. Now, no question about it, he was a builder of the system; he contributed an enormous amount to advancing national park interests. But he remained very, very conservative regarding natural resource management. As it happened, I think he spent half of his later life at the typewriter; he was constantly corresponding with the superintendents and directors and whomever. So there was a great paper trail left by Albright and I often used him as the voice of traditional management. Even though he was outside of the Service, he was real close to the Service for the rest of his life, and shared mainstream NPS perspectives.

YS: His visits were like presidential visits! I have a feeling that deference to Horace, this non-government guy, had an effect on all these managers who wouldn't take on anything that they thought would annoy Horace.

RS: Had Albright been converted to contemporary ecological thinking, let's say in 1935 or 1937 or 1940, and had he told the leadership of the Service that "these wildlife biologists have a point...we really need to take this into account," he could have had a more positive effect on natural resource management than the Leopold Report. He had enormous influence on the Service. He was one of the founders. He and *[former director Conrad]* Wirth and [*former director George*] Hartzog, were men who really did contribute an enormous amount to expanding the National Park System, and they must be given credit for that. But as far as ecology goes, no. Hartzog made some moves in that direction, and Albright some, early on. But certainly not Wirth.

YS: I think it's a small enough agency that through force of personality someone like Albright could clog up, at least retard, the changes that might otherwise have occurred. I think that's interesting history, because I'm not that convinced that it happens all that much, where someone just through force of will and a strong typewriter keeps such tight tabs on "the children" for so long. Albright would at times set himself up as the hero who stopped predator control, and I'm sure Horace believed it! Forty years later it's a great story. All you have to do is look at the record to know that "it wasn't like that, Horace." How did you take on the icon that was Horace?

RS: I let him take on himself. Of course, I'm the one who selected which documents to use. But I let him speak for himself in the 1930s and '40s and '50s and into the '70s. And in most cases I left it to the reader to make a judgment about Albright. But his positions were very clear.

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YS: At least in Park Service culture you're not yet vilified for daring to cast a little taint on Albright.

RS: Twenty years ago I would have been...

YS: I wonder if you think that, today at least, we in the Service understand and embrace the need and value of science to do better management?

RS: Yes. I think it's advanced slowly. We have obviously far more scientific input on decision making than we did in 1963 when the Leopold Report was written; there is no comparison. At the same time, it's very clear—the Vail Agenda makes it clear, the 1992 National Academy Report [*another review of NPS science programs*] makes it clear—that we have not addressed our scientific needs adequately. I think the Service is quite short of staff for natural resource management, and while we've made progress, we haven't made the kind of determined progress that we should have. And we haven't made the kind of progress that we made, for instance, in law enforcement. When that became a high priority we jumped right on top of it [*snaps fingers*]. The interpreters would say that they're hurting right now, too, but in the 1960s there was a big push for interpretation and for living history and things of that sort.

The Service will push for what it really wants and toward where its heart really is. I explain in the book how a variety of programs evolved in the post-Leopold era. And that the emergence of scientific resource management had to contend with a Service that was looking in other directions and had other priorities.

Now, I think we need a strong training program in natural resource management. If we're a natural resource management agency, which we continually say we are, we need a training program that is at least equal to that of law enforcement. Why not?

YS: That's the question. It doesn't look to me like the decision makers ever sat down together over the past 30 years and had some sort of gentleman's agreement—like major league baseball had for 70 years to keep black people out of it—to keep science on the back burner. It looks like it's one of those inadvertent priority things. Law enforcement, when it took off, was really easy to get funding for compared to a lot of other things. And interpretation has always struggled, it's always been expendable; it amazes me that we have as much of it as we do. What were the things that kept science from growing? Perhaps it's that there really isn't a clear enough mandate there—it's a mandate that has to be partly intuited from another mandate, which is "do a good job."

RS: The next-to-last chapter of the book deals with the "State of the Parks reports"—there were two of them (in about 1980-1981), and after that, I use a question that the 1991 Vail Conference on national parks raised—one of its four major concerns—the role of the National Park Service as an environmental leader. If our primary mission is resource preservation, why isn't that our primary focus? Where is our reality as opposed to our rhetoric? For a top-notch preservation program, the NPS needs to have a very strong training program—for people who are already in the Service and for people coming into the Service and for natural resource managers and for superintendents and other individuals in the Service who are related to those programs.

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YS: In 1992, the National Academy did a wonderful job in listing all the people who agreed that the parks needed science; they said we needed to find a way to institutionalize science. It doesn't seem to be happening in any formal bureaucratic way. In fact, it appears that the opposite has happened, because our science has been taken away from us—presumably to make it better, but I don't really believe that. How do we change then?

RS: I would like to see the National Leadership Council [*senior NPS managers from the regional and Washington offices*] totally committed to the values that natural resource managers have and acting on those values on a daily basis. And I think that the way the service change is if natural resource management is given access not just to the rank and file positions but to leadership positions throughout the Service in the parks and the central offices. I don't mean necessarily they have to be directors, but they need to be in line authority at very high positions if indeed resource management is our primary function.

YS: Is that what's happening, slowly?

RS: Very slowly; quite slowly. Traditionally the natural resource managers have been pretty much been dead-ended in those positions and their career paths have not been open to the upper-level management positions. As I understand it, part of the resources career initiative is that there will be a clear career path for resource managers—cultural as well as natural—to upper level management positions. And there absolutely should be. Until that happens, and until people (mainly with master's degrees in the natural sciences) are provided with sophisticated training that includes environmental politics, park management, and supervision—that is, not just in natural resource management, but in how to be upper level managers—until individuals with those kinds of backgrounds get in at the very top, I think that there's going to be a continual frustration with the Service for not rising to its real potential as a leader in the preservation of the natural environment.

YS: The people who are in charge now, the leadership that isn't characterized by those sentiments and by the natural resource managers' attitudes, how do they respond to this criticism? What are their positions?

RS: Some of them will agree with it and support change. Others will either oppose it openly or behind the scenes. There's a bit of history to this. The Leopold Report states—I have forgotten the terminology it used—that the big natural

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resource parks should be under people with biological training. And the report did not mean, I'm sure, only six hours in undergraduate school. And in my opinion that statement, if made to a superintendent who had come up through the ranger ranks and had a degree in recreation or something similar, and then became a superintendent, it would be a threat and a challenge to their traditional leadership. And what I'm saying today is also a challenge, in the sense that I think the Service should reconsider the nature of its leadership.

What really concerns me is that there should be natural science expertise and resource management expertise near the very top. I don't think it necessarily has to be the superintendent, but I would have it right below the superintendent, and in line authority. Why should Yellowstone—this is a world heritage area, it one of the premier national parks of the system because of its natural resources—why shouldn't it have someone with natural resource management expertise and a strong background in the natural sciences in line authority, at the very least as a deputy superintendent?

YS: We don't have a deputy superintendent, but the Director of the Yellowstone Center for Resources acts somewhat like a deputy superintendent.

RS: As I understand it, he has control over the research aspects. But does he have much authority over park-wide budget, planning, staffing operations, and so forth? Also, I frankly see protection as one subset of preservation, and I don't know where the rangers in Yellowstone are in all of this. I'm talking about a position that has authority over most everything going on in Yellowstone. It's fortunate that your resources director has built up a lot of strength here. If he were to leave, who would replace him? How strong and how effective would that individual be? What I'm talking about is not the strength of individuals, but institutionalizing this kind of thing throughout the system.

YS: The leadership which resists enough science, are they just an aging subset of Horace Albright clones? What is their rationale? Why do they not embrace it more? Do they just merely say, I'm too busy with visitor use issues? Do they have other things that they just regard as higher priorities?

The Leopold Report states...that the big natural resource parks should be under people with biological training. And the report did not mean, I'm sure, only six hours in undergraduate school ...it's a threat and a challenge to their traditional leadership...I think the Service needs to reconsider the nature of its leadership now and in the future...Why shouldn't Yellowstone...have someone with natural resource management expertise and a strong background in the natural sciences in line authority, at the very least as a deputy superintendent?

RS: You've said it. There is a vast array of competing priorities in the parks. And they're simply answering to others, and science and natural resource management questions don't impinge on them as much as, say, concession operations.

YS: I've had a suspicion that part of it was that when we have science, people think it caused management so much more trouble, or controversy. One of the reasons that we created *Yellowstone Science* is because we kept hearing that "you have no science there." But take the Craighead controversy over grizzly bear management [*see Yellowstone Science VI(1)*]. Ah, we had some science there—well, look what happened; that caused more trouble! Or the northern range and that controversy—we've had lots of science there—that's caused us nothing but disagreement. If people are aware that we have done research, they are not clear that it helps in making decisions.

RS: Scientists don't come up with management plans or decisions.

YS: They just disagree! So, does that influence managers, either by thinking the scientists are going to cause us nothing but trouble or they're really not going to help give us the answers?

RS: I address this problem in the book. How much the managers articulate this among themselves, I'm not sure, but I think it's pretty clear to them that, with an infusion of science, management becomes more costly, more time consuming, and a lot more complex. And the problem with science is that it often raises more questions than it answers, or attempts to answer. Ecology is just that complex. So I think that these factors have caused resistance, particularly since the Leopold Report. But also in the George Wright era there was a resistance to scientifically informed management because of such factors: cost, delays in decision making, and restrictions on managerial authority. If scientists come up with a decision on the northern range, or on the grizzlies, or the bison that goes against what the superintendent deep in his heart wants to do, then it's a restriction on his freedom to operate. It's a threat to traditional management.

You raised something that I would like to go back to, briefly. I see Mission 66 as the principal turning point in national park history. With Mission 66 we were into very heavy development, well-funded by Congress and moving right along. And that put us even more clearly in opposition to the direction the conservation movement was taking. They were moving toward the Wilderness Act; we were moving toward paving roads and building new visitor centers and other kinds of development. So we found ourselves really at cross purposes. Not only that, no longer did the environmental groups have the clubby, tweedy, bowser-club relationship with Park Service leaders they once had. It was a much more confrontational relationship. I quote Wirth on this: "they [*the environmental groups*] believe the Service is the enemy."

Then on top of that the Leopold Report was dropped on us in 1963—it was, in effect, an expression of the conservation movement's concerns for the parks. And that same year, the National Academy came out with its first report. That's one instance where I used a bit of oral history. I talked with Howard Stagner, who had been high in the Park Service administration at that time, and he made it very clear that Conrad Wirth had suppressed the

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National Academy's 1963 report by not publishing it, but simply putting it out in typescript. He didn't want to share that criticism with the public.

YS: I've never seen it cited.

RS: That is what Wirth wanted; he didn't want you to see it.

YS: It worked! Is it amazing that the Leopold Report actually took hold as much as it did?

RS: In the George Wright era, and earlier, when there was criticism of the Service it was mainly on the type of development occurring and its appearance, not so much its effect on ecology. There was little outside support or involvement with natural resource management, per se, in the 1930s in the parks. By the 1960s, that had changed. There was an outside voice, a very powerful voice, working in a very well-organized, politically well-connected way and becoming more powerful as the decade progressed—concerned not just with the appearance of development, but with what development and public use was doing to the ecological systems in the parks. So it was a different game. And the Leopold Report was backed by Secretary of the Interior Stewart Udall.

YS: He was not in a position to suppress it, having already more or less endorsed it by setting it up.

RS: The Leopold Report had more influence on natural resource management than the National Academy Report did, but the National Academy Report had more influence on the organizational situation for the biologists. The Academy argued for an independent biological program, one that was pretty much free from interference from management.

Organization is power, it reflects power, it reflects priorities. In my book I discuss organizational sociology and what the values of the Service were, how they were reflected in the programs and in the leadership of the Service. If you look at the organizational charts across time you will see the development-oriented professions—landscape architecture, forestry, and so forth—moving right along at the top. By contrast, it was 15 years from the time the Leopold Report was written until the time an associate director [*for science and natural resources*] position was created in Washington. That came in 1978. During that 15 years, the science programs (their organizational status) would rise and fall. Starker Leopold was in for a year as chief scientist, and during that time science rose. It also happened to rise under [*former NPS director*] Ron Walker and I think that was in part because Walker did not know the Service well; he wanted to rely on professionals in the service, and he actually brought up the scientists.

YS: None of us seem to have been terribly enthralled with the recent creation of the National Biological Survey (NBS) which then became the Biological Resources Division (BRD) of the USGS. This came about by transferring all Interior Department scientists from other agencies including the NPS. Does your research come up into this period enough that you can comment on whether this has been a significant happening?

RS: I mention it briefly. My feelings were that the closer I got to the present the more journalistic the writing would be. And I would have had to spend at least two more years on this project in order to get fully on top of the details of what had happened in the 1980s and the early 1990s. But I do mention the creation of the NBS and then later the BRD. In my mind, it was a mistake to pull science out of the NPS, at this point anyway. The new arrangement might improve over the next decade or so, but in the future, after the Clinton administration and after [*Secretary of the Interior*] Babbitt, I'm not sure how much determination there will be to make sure that it works for all the different agencies involved, including our agency.

YS: Twenty-some independent scientific reviews have basically all said the same things since the 1960s—that we still need more and better science and resource management. If our culture had demanded it, we would be getting there, and obviously we're not. So perhaps it's because there has not been either internal demand from the Park Service culture or the external demand from Americans who still seem pretty darned happy with what they are finding here. For many visitors a park experience is still a museum: "I've got to see the elk, I've got to see the bison, I've got to see the wolves"...it's a collection of things, artifacts, buildings. We certainly have not taught them about the ecological processes and change.

RS: Yes, but you can't do that overnight. I think what we really want to do is build an environmental ethic. An appreciation of natural beauty—the moose, the elk, the bison that visitors see, and the landscapes, and the forests in national parks—is for many people a threshold toward a greater and deeper understanding of the natural world, a greater ecological sophistication. That's one thing I certainly credit the Park Service and the national parks with. And this influence comes through their interpretive programs and through the presentation of the parks, and through making the parks accessible, through building this big circle-eight road system in Yellowstone so that people can get out and see these things. It is an interference in the natural system of things, but it also opens it up to the public. I do think that aesthetics is a route toward a deeper appreciation and understanding of the natural world.

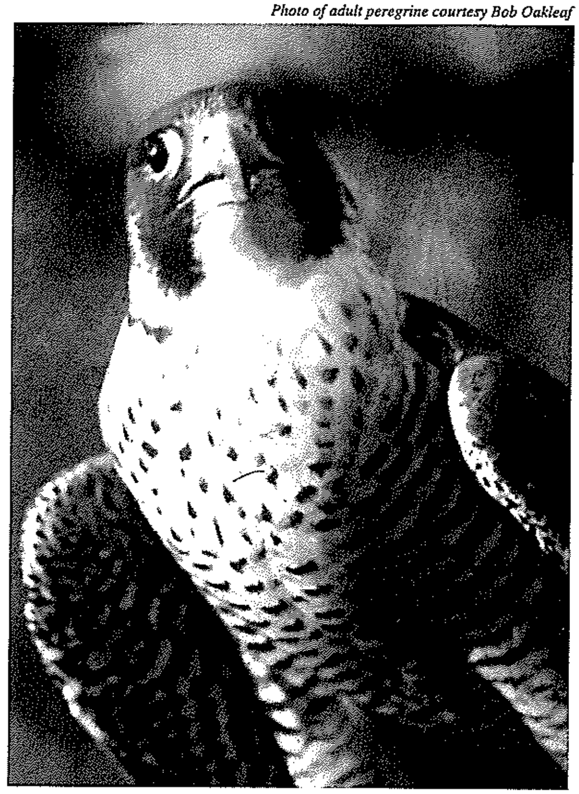
Again, I do not see ecologically informed management as being incompatible with tourism. I think it can be worked out properly. I think indeed if resource preservation is our highest priority, then it should be reflected in our operations, our budget, our planning, and things of that nature. And we could do so much better...

Greater Yellowstone Peregrine Falcons:

Their Trials, Tribulations, and Triumphs

by Terry McEneaney, Bill Heinrich, and Bob Oakleaf

Photo of adult peregrine courtesy Bob Oakleaf



It was a cold, red sunrise in May in the mid-1970s. Snow was still on the ground, especially under the lodgepoles. Yet Pelican Creek was open and teaming with waterfowl. As we stopped the car to observe a blue-winged teal, we rolled down the window to hear the wonderful bell-like call of the drake when, suddenly, the teal was silent, motionless, and alert. Then we heard a far-off sound resembling a jet coming closer. The sound got louder, until the annoying noise, like a race car changing gears, passed over the car leaving a "Doppler effect" in our ears. In a matter of seconds the beautiful teal was airborne, and in a split second there was an apparition of another bird that entered our view. The energetic teal could no longer be seen, but the teal's feathers were drifting in the air not far from where it flushed. When the commotion settled, there remained on the ground the lifeless form of a blue-winged teal that was being eaten by one of the most majestic birds in the world—a peregrine falcon.

Five minutes after the peregrine had begun feeding, another phantom image appeared on the scene. Its entry was announced by the screeching calls of the alert peregrine as it stopped feeding on the teal, and the introductory notes clearly identified the intruder as a common raven. The raven flew into the scene and stole the lifeless teal from the falcon. In retaliation, the peregrine began attacking the intruding raven by reeling in circles, screaming, and dive-bombing. The raven was so alarmed by the airborne falcon that it caused the hackle feathers on the raven's neck to rise. To avoid serious injury from the attacking falcon, the raven dragged the teal from a sandbar through the sedges and eventually under a willow. After ten minutes of attack dives, the peregrine gave up. The sky was soon clear of the peregrine. The raven, due to its size and demeanor, was fortuitous, in this instance, to prevail. But for diminutive birds the size of a teal and smaller, the sky is seldom devoid of peregrines, wandering marauders of the skies. This observation by the senior author and a friend was a rare sighting then, and since peregrines are uncommon even today they largely go unnoticed. But the times have changed, and so have their numbers. The information we present is an update on the history, ecology, and status of the peregrine in greater Yellowstone.

Unique Bird With a Clouded Past

The peregrine falcon (*Falco peregrinus*) has been admired by naturalists and falconers for centuries, due to their marauding habits, swiftness of flight, striking colors, and extensive global distribution. Of all the birdlife on Earth, only the osprey and the common raven rival the peregrine in their global breeding distribution and hence occur on all continents with the exception of Antarctica. The specific name *peregrinus*, or peregrine, is a Latin derivation that means pilgrim or wanderer, in reference to the great wanderings or migrations this bird makes.

The history of the peregrine falcon is clouded with trials and tribulations. Beyond the beauty of the bird, the incredible flight, the sensational action, there crept an insidious problem that affected peregrines that would not be detected for years. It first came to light in Great Britain in the 1950s, when in a short time a high percentage of breeding pairs failed to produce young. A budding biologist by the name of Derek Ratcliffe was beginning a detailed study of the peregrine in Britain and through intensive investigation came up with a remarkable discovery that surfaced around 1962. Ratcliffe observed a high incidence of egg loss during incubation.

In eastern North America, a similar trend was developing—nests were failing and breeding adults were not only declining but disappearing from traditionally known eyries. The alarming movement was so widespread that similar problems were later identified in the western United States by the mid-1960s and in the Arctic by the early 1970s.

Ratcliffe and his British colleagues suspected toxic chemicals when they found high levels of chlorinated hydrocarbons in the first peregrine egg ever to undergo chemical analysis. Another important event that occurred was the global assemblage of peregrine experts at the International Peregrine Conference held at Madison, Wisconsin, in 1965, hosted by Joseph Hickey and the University of Wisconsin. Evidence presented at this conference pointed to a relationship that corresponded in time with the decline of the peregrine in Britain and the wholesale application of DDT (dichloro-diphenyl-trichloro-ethene) and dieldrin for agricultural purposes.

Still, definitive evidence connecting toxic substances to unusual breeding declines in peregrines could not be adequately proved. Ratcliffe, through his persistence to get to the bottom of the problem, was instrumental in making one of the great avian scientific discoveries of the twentieth century. His curiosity kept him revisiting his detailed observations of the alarmingly high frequency of broken eggs, of adults digesting eggs, and the inexplicable thinning and weakening of eggshells. By visiting museums and private collections of eggs collected between 1900 and 1967, Ratcliffe was able to measure eggs and pinpoint a remarkably short period, 1945 to 1947, when there was a 20 percent decrease in thickness of peregrine eggshells. This eggshell thinning corresponded precisely to the time of heavy application of DDT and other insecticides on a broad landscape level. This strongly implied that one or more of these chemicals produced physiological complications for egg-laying female peregrines. Ratcliffe's findings were quickly confirmed by biologists in North America conducting similar studies. By 1969, the American peregrine falcon (*Falco peregrinus anatum*) was listed as endangered by the U.S. Fish and Wildlife Service. The supporting evidence over the years has proved that DDT and its breakdown products, most notably DDE (a derivative of DDT), were responsible for eggshell thinning and breakage, and related reproduction and population declines in a wide spectrum of raptorial and piscivorous birds. Rachel Carson, in her monumental 1962 book, *Silent Spring*, brought to light the fact that chlorinated hydrocarbon pesticides not only killed target organisms but disrupted and, in some cases, destroyed food chains and food webs, and negatively influenced ecological processes. The data gathered from other bird studies only strengthened the case of the peregrine, which led to more restricted use and the eventual banning of DDT in Britain and North America by 1972.

Life History of the Peregrine

It is difficult to adequately describe a peregrine in prose, for the bird evokes a different image with different people depending on their degree of experience and exposure with the bird.

Peregrines are slightly larger than an American crow (*Corvus brachyrhynchos*). Adult females (also referred to as falcons) are typically larger than males, weighing on average 30 oz. (850 grams), while males weigh 20 oz. (567 grams). Thus, males are also referred to as tiercels, which means "one-third smaller." From head to toe they are 15 to 20 inches (381 to 508 mm) long. In flight their wings are 40 or more inches (1,106 mm) long, and they are characteristically pointed in appearance. Adults are dark blue or slate-colored, especially on the back, wings, and tail. The cere (fleshy material covering the nostrils) and the feet are yellow to orange in color. Adult peregrines have a black helmet appearance on the head that extends below the eyes, in contrast to a white throat and sides of the neck. The mid- to lower breast is horizontally barred and gray-white, as are the belly, leg feathers, and undertail. Immature birds are similar in size and appearance, but have darker brown feathers in contrast to the gray or slate-color of the adults; immatures have pale gray to yellowish feet and cere and vertical streaking on the breast.

In greater Yellowstone, peregrines nest on cliffs, often overlooking open country. Each nest or eyrie consists of a simple scrape on a gravel ledge. Sometimes they will nest in an abandoned raven or golden eagle nest. They generally lay three to four eggs that are heavily marked with red-brown splotches. Their incubation period is 33 days. These birds can be easily disturbed during incubation, and eggs have been known to roll out of the nest when incubating females are suddenly disturbed. The period from hatching to fledging usually takes 42 days.

The colorful appearance and demeanor of the peregrine falcon seldom passes unnoticed, but what gets the attention of the field observer is the superb flying ability of this avian marvel. Peregrines hunt either from a perch, while in flight, or employing a combination of the two techniques. By perching on a vantage point, such as a tree or cliff overlooking large expanses of open space, the predator has a commanding view of the area and watches for prey victims that are vulnerable being away from safe cover. Peregrines can directly attack on the wing but have an added advantage if they can get above their victims. The hunting falcon, once maneuvered into position, has the ability to "stoop" or dive at fast speeds, thus overtaking its victims. How fast they travel is open for debate. In level flapping flight they typically travel 40 to 55 miles per hour; however, the terminal velocity of a peregrine in a stoop can be in excess of 200 miles per hour. All prey are disabled by the striking feet. Smaller prey species can be caught and killed in mid-air, whereas larger prey are struck with the feet and disabled or killed outright and retrieved on the ground.

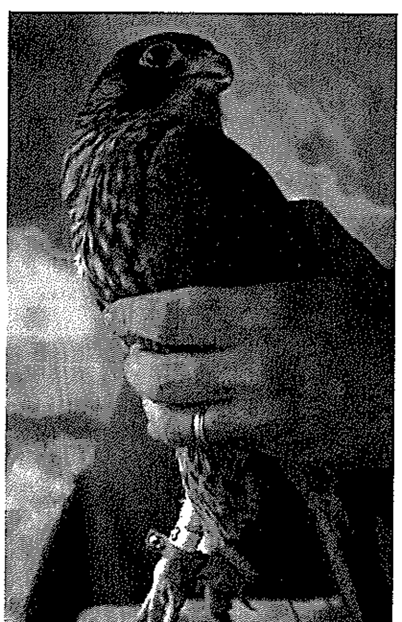
The peregrine falcon is an incredible bird predator. The type of birds a peregrine pursues depends on whether the pursued is another predator, a simple intruder, or vulnerable prey. Male peregrines typically pursue small prey that weigh 0.7 to 7 oz. (20 to 200 grams), whereas females can pursue slightly larger prey ranging from 3 to 35 oz. (100 to 1000 grams). Although these birds have been called "duck hawks" for the way they pursue waterfowl, or "the great-footed falcon" in reference to their large feet used for securing prey, they have the ability to kill a diverse array of birdlife. Some prey species that have been observed taken by peregrine falcons in greater Yellowstone include: yellow warbler, yellow-rumped warbler, western tanager, mountain bluebird, northern flicker, Clark's nutcracker, Wilson's phalarope, common snipe, yellow-headed blackbird, red-winged blackbird, Townsend's solitaire, red crossbill, cliff swallow, tree swallow, green-winged teal, blue-winged teal, cinnamon teal, killdeer, Franklin's gull, eared grebe, Caspian tern, and black rosy-finch.

We have witnessed a variety of encounters, most typically in pursuit of other peregrines for territorial defense, but golden eagles are also highly feared by peregrine falcons. Encounters with intruders such as common ravens and prairie falcons are quite common. More unusual sightings documented in greater Yellowstone include encounters with a rufous hummingbird in the Thorofare, chasing trumpeter swans out of a nesting territory in the Centennial Mountains, and a similar encounter with American white pelicans over Yellowstone Lake. Other oddities observed have been a medium-sized fish brought into an eyrie in the Grand Canyon of the Yellowstone, and a small fingerling caught by a peregrine in Hayden Valley.

Photos courtesy Bob Oakleaf

Biologists Heinrich, Oakleaf and attendents, who access cliffs by hiking and climbing, prepare to place young peregrines in a hack box.

The breeding range of the peregrine encompasses approximately one-half of the North American continent and includes the following areas: northern Alaska, northern Mackenzie, Banks, Victoria, southern Melville, Somerset, and northern Baffin islands, and Labrador south to southern Baja, California, the coast of Sonora, Mexico, southern Arizona, New Mexico, western and central Texas, and Colorado. Less frequent numbers occur in the Sierra Madre Occidental of northern Mexico, and at least formerly ranged to Kansas, Arkansas, northern Louisiana, Tennessee, northern Alabama, and northwest Georgia. Generally speaking, the northernmost populations migrate most often to tropical regions, while populations in warmer climates are relatively sedentary and either don't migrate at all or migrate short distances.



Band returns confirm that Mexico is a stronghold for wintering peregrines.

Spring migration ends with the arrival of adult peregrines in Yellowstone, between late March and early April. They usually depart this area in October, with late departures extending into November. Although wintering data is weak and incomplete, we do have some information worth sharing. Two band returns from peregrines banded in greater Yellowstone shed some light as to where peregrines spend the winter. One came from the state of Sinaloa and the other was from the state of Jalisco in western Mexico. Jim Enderson, a Colorado College biologist who has spent a lifetime studying peregrines, suspects their primary winter range to be Mexico and northern Central America. These band returns confirm that western Mexico is a stronghold for wintering peregrines. Both coastal and interior areas are equally important, since they attract large concentrations of shorebirds and waterfowl and large flocks of passerines such as common grackles, brown-headed cowbirds, Brewer's blackbirds, yellow-headed blackbirds, and red-winged blackbirds.

Peregrine History and Recovery in Greater Yellowstone

Yellowstone is unique in that it has a rich historical record documenting the existence of this species as early as 1914. Milton Skinner was the first to record the status of the peregrine in the park, but the information was so vague that it provided little value regarding populations. In 1924 and 1938, Edward Sawyer (a naturalist for the park) provided more meaningful data, giving us some reference as to the existence and location of nesting peregrines. In the 1960s, Jay Sumner, John Craighead, Jim Enderson, Bryan Harry, and a few others provided important pieces of information that contributed to the construction of the peregrine puzzle. Enderson kept a few records of nesting peregrines in the 1960s, while Sumner kept intermittent track of several known historically occupied sites from the 1970s through the early 1980s. The Wyoming Game and Fish Department monitoring some traditional eyries in the late 1970s and early 1980s and found the sites to be unoccupied by peregrines. However, due to the fragmented nature of the Yellowstone peregrine information up until the 1980s, we never knew the total number of peregrine eyries that historically occurred in and around the park. Due to the era and the technology of the time, this information just wasn't available. But the information still proved to be extremely important, especially when assessing the status of peregrines in the greater Yellowstone.

The road to recovery for the peregrine started with the restricted use of DDT in Canada in 1969 and a total ban of this pesticide in the United States in 1972. Coupled with this major breakthrough was the establishment of The Peregrine Fund, by Tom Cade at Cornell University, in 1970, whose goal was to ensure the survival of the species. Three regional facilities (in New York, Colorado, and California) were responsible for the captive breeding of peregrine falcons. Later, the New York and Colorado facilities would be merged into one, called the World Center for Birds of Prey located in Boise, Idaho, under the superb direction of Bill Burnham. Today, the center has a mission to restore many species of environmentally threatened birds into the wild, but the emphasis is more global in scope. Since the 1970s, over 3,900 peregrines have been released into the wild in 29 states.

The first release of captive-raised peregrines in greater Yellowstone occurred in 1990. A total of 11 young were released at three different sites in the Jackson Hole area of Wyoming. First efforts in Montana occurred in 1981 when four young were released from one site in the Centennial Valley. Idaho followed suit in 1982 when eight young were released from two sites on the western edge of greater Yellowstone. And in 1983, four captive-raised young peregrines were released from one site in Yellowstone National Park. Releases were run by the Wyoming Game and Fish Department, with financing by them, other federal agencies, and The Peregrine Fund.

While reintroduction efforts continued, a major milestone was reached in 1984, when two pairs of breeding peregrines were discovered in two different areas of greater Yellowstone. One pair was found on a historically occupied site in the Grand Canyon in Yellowstone National Park, and the other on a cliff in the Centennial Valley of Montana. Needless to say, it didn't take us long to crack open the champagne and beer.

Searching for peregrines is best done from the ground. It requires supreme patience and is very time-consuming. Collecting occupancy and production data requires a minimum of three and up to six visits per nest site. Site visits often require monitoring a cliff for an entire eight-hour day. Monitoring requires countless hours of expertise; subtle peregrine behavioral clues and keen observational notes determine the status of an eyrie. This involves using binoculars, high-quality spotting scopes, an attentive ear, and a sharp eye. Grizzlies are always a concern, so observers are constantly looking behind themselves as well as at the peregrines.

In the earlier stages of the peregrine falcon reintroduction effort, nearly all adults found occupying sites were banded, indicating that these birds were originally released from hack boxes. In 1985, for example, both the male and the female in the Grand Canyon of the Yellowstone were marked. The male was banded and released from a site on the Targhee National Forest in Idaho; the female was from a Jackson Hole hack site. Over the years, fewer banded adults were observed at traditional eyries, suggesting that recruitment was becoming more dependent on natural production as compared to initial recruitment from artificial release sites.

The progress we have seen in greater Yellowstone and in particular Yellowstone National Park (YNP) epitomizes the success of the peregrine reintroduction effort. In 1984, the one YNP pair that was found produced three young. As the population increased, reintroduction efforts slowed and were terminated in the park following the summer of 1988. As of 1997, we were proud to report that 13 pairs of peregrines produced 25 young (Figs. 2 and 3). Significant gains have been made in all three states adjoining the park (Figs. 4 and 5), with a large percentage of the population increases having

Falcons and Fire

The 1988 wildfires had no effect on peregrine falcon occupancy or production. Although some cliffs became unstable following the cataclysmic events, the senior author was in Yellowstone monitoring birds throughout the summer of fire, and observed that some birds had to move to other cliffs. But the overall outcome had no effect on peregrines or their offspring. In fact, due to the increasing trend in peregrine numbers, the last hacking effort in the park occurred in 1988 (Fig. 1).

Figure 1.

Peregrine Falcons in Yellowstone National Park

Total Young Placed in Hack Boxes by The Peregrine Fund

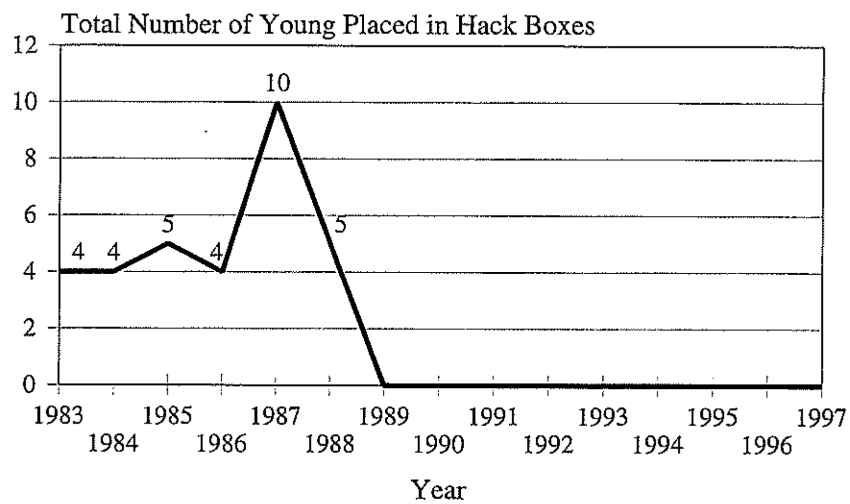


Figure 2.

Peregrine Falcon Occupied Territories

Yellowstone National Park

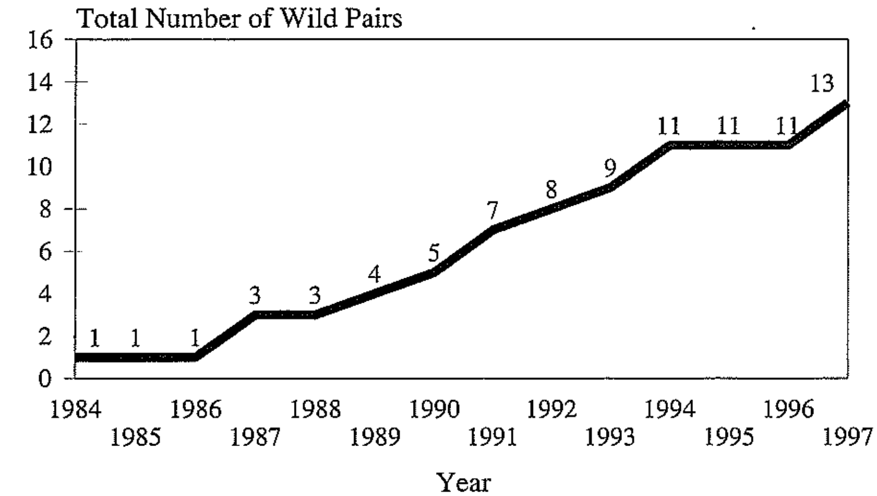


Figure 3.

Peregrine Falcon Productivity Yellowstone National Park

Total Fledglings Produced from Natural Eyries

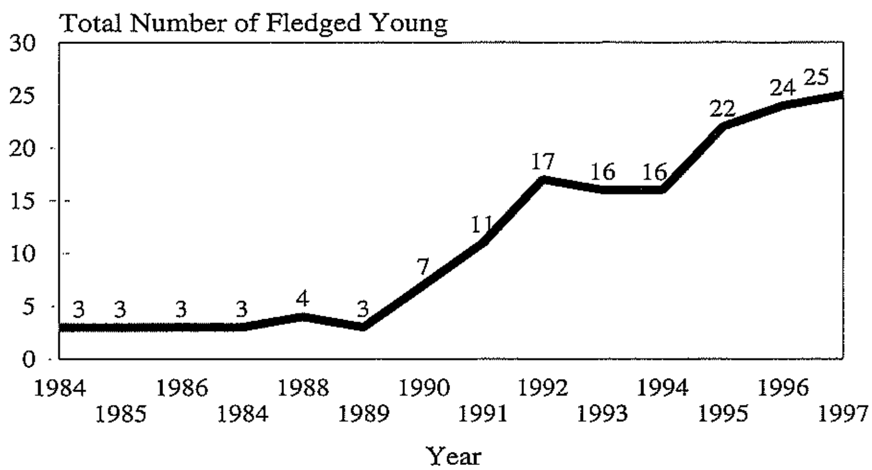
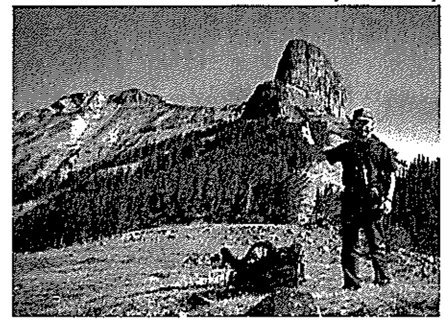


Photo courtesy T. McEneaney



Biologist Terry McEneaney below the 10,220 ft. eyrie on Colter Peak, Yellowstone National Park.

occurred in greater Yellowstone. Reintroduction efforts ceased in Idaho in 1994, in Wyoming in 1995, and in 1997 in Montana. Even though not all of the traditional eyries in greater Yellowstone are currently occupied, we have located many eyries that were previously unknown. Also, we thought we understood the habitat requirements of the species. But the discovery of an eyrie at 10,220 feet on Colter Peak only emphasizes the wide variation of nest sites available for peregrines. This site is the highest known peregrine eyrie in North America at this latitude. Latitude plays a big role in plant and wildlife distribution; treeline in Glacier National Park is at 7600 feet elevation, but is at 10,000 feet in Yellowstone and even higher still in Colorado. Eyries are lower in the more northerly latitudes. For an eyrie to be this high this far north is remarkable.

Idaho, Montana, and Wyoming have benefitted from The Peregrine Fund's reintroduction program as evidenced by the 1997 results. The greater Yellowstone proved to be an important area for peregrine establishment in the northern Rockies and is expected to play a significant role as they pioneer other areas of Wyoming, Montana, and Idaho. In 1986, a greater Yellowstone working group set a goal of 30 peregrine pairs in the tri-state area by 1990; the goal was met in 1989. Then Wyoming added its own goal of having 30 pairs in northwest Wyoming by 1996, and achieved this by 1994.

Looking Toward the Future

The future of the peregrine falcon in greater Yellowstone looks very promising. By delving into the past we found that even though greater Yellowstone is perceived to be a pristine environment, DDT was sprayed in and around the park in the 1950s to combat spruce budworm infestations. The result of this effort contributed to the demise of the peregrine and other top food chain consumers in this unique ecological area.

The banning of DDT in 1972, coupled with the superb effort by The Peregrine Fund and their associates to restore peregrines in the wild, changed the status of the peregrine in a relatively short time. We are in consensus that the peregrine is ecologically recovered in greater Yellowstone and other areas of its former range in North America. It is just a matter of time before the U.S. Fish and Wildlife Service will reclassify the peregrine falcon as a recovered species no longer needing special protection under the Endangered Species Act. Once the species is officially delisted, efforts will be made to allow designated public viewing areas

Figure 4.

Total Number of Wild Peregrine Pairs

Wyoming, Montana, Idaho

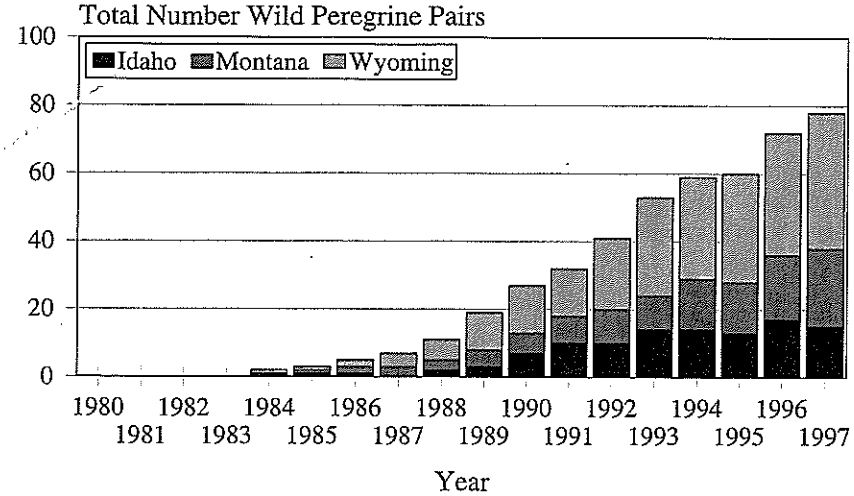
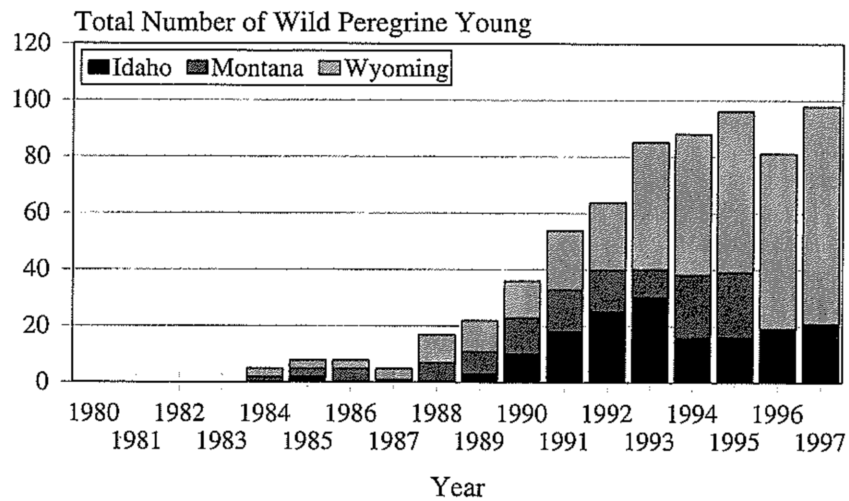


Figure 5.

Total Number of Wild Peregrine Young

Wyoming, Montana, Idaho



in places like Yellowstone. But monitoring efforts need to continue to ensure the survival of this remarkable species. This will require a long-term commitment by state and federal land management agencies.

Although the peregrine had its share of trials and tribulations, triumphs came from the partnerships that were formed between individuals working for a common cause. The success of the peregrine falcon recovery program in the greater Yellowstone required teamwork. The primary credit needs to go to The Peregrine Fund and its staff. Although not everyone can be mentioned, key people that quickly come to mind for their hard work and dedication include: Barb Franklin, Ed Levine, Brian Mutch, Dale Mutch, Dan O'Brien, Dan Stevenson, Jim Willmarth, and the countless number of hack sites attendants. It was also gratifying to find state and federal and nonprofit organizations working together for a common conservation cause. The achievement is a testament to the dedication of concerned organizations, agencies, and individuals.

But the ultimate triumph was the success of this grand experiment of reestablishing peregrine falcons into one of the wildest places in the lower 48 states. The peregrine falcon will go down on record as one of the great symbols of environmental conservation in North America and in greater Yellowstone. We are proud to have played a part in it.

Terry McEneaney is the staff ornithologist for Yellowstone National Park. Bill Heinrich is the species restoration manager for The Peregrine Fund's World Center for Birds of Prey in Boise, Idaho. Bob Oakleaf heads the non-game program for the Wyoming Game and Fish Department. These and many other biologists and cooperators formed a cohesive team to help bring back the peregrine to greater Yellowstone.

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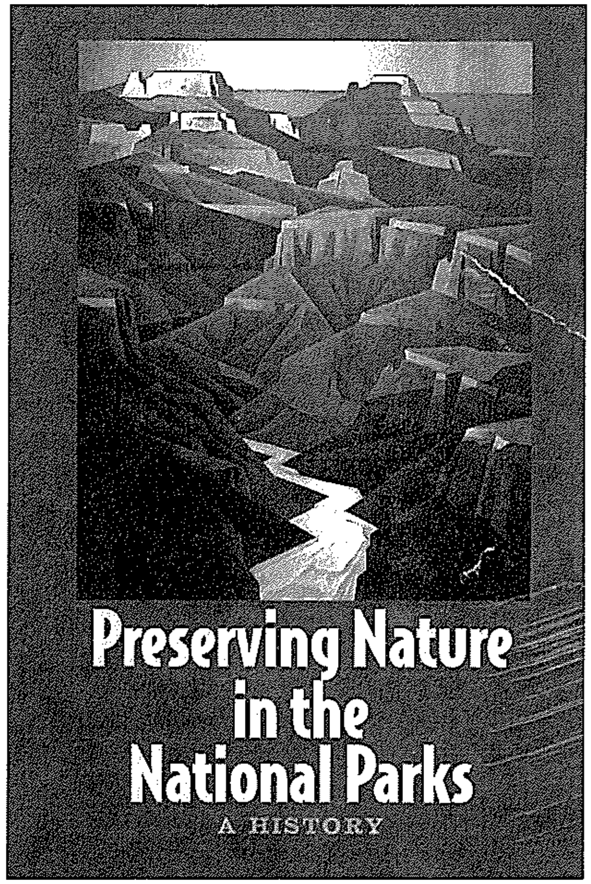
Book Review

Preserving Nature in the National Parks: A History *by Richard West Sellars. Yale University Press, New Haven, Connecticut, 1997, 364 pages. $35.00 (hardcover).*

Ever since the National Park Service (NPS) was established in 1916 there has been a constant debate over which component of the mission should be dominant—preservation or public enjoyment and use. In *Preserving Nature in the National Parks*, Richard Sellars immerses the reader in the history of National Park Service management and how, more often than not, development for ever-increasing visitor use has won out over the preservation of natural systems.

In this exhaustively researched and annotated book, Sellars takes us on a roughly chronological journey through the history of the Park Service, each chapter covering a block of years, each block with a theme that was particularly prominent during that time in history. The book could almost stand alone as a fairly complete historical account of the National Park Service, but that's not really its purpose; rather, I think it is designed to teach us a lesson: while Park Service management has always had good intentions, nature has often suffered due to ecologically poorly informed decisions.

Before reading the book, I thought I had a pretty good basic understanding of NPS history. What surprised me was how strongly ingrained the priority of public use and enjoyment was in the early years of the Service, especially for Stephen Mather and Horace Albright, the founders and first directors of the Park Service. Even after Albright left the government to spend the rest of his career in private industry, he would continue to be actively involved in furthering his ideas—one of which was the manipulation or ignorance of ecosystems to (as he saw it) benefit the visiting public. However, when one looks back at the philosophy toward nature at the beginning of the century, it isn't surprising that the young science of ecology took a while to become accepted by park managers. Even today, we see staunch opposition to many ecologically sound management practices such as wolf restoration and free ranging bison.

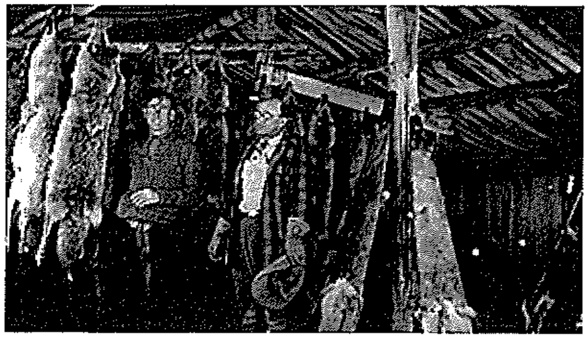


Nevertheless, in the early 1930s there were many vocal wildlife biologists urging the Park Service to start changing some policies for the benefit of wildlife and ecosystems, instead of merely "preserving the scene" or manipulating nature for the amusement of visitors. In 1933, three NPS wildlife biologists published a report that became known as *Fauna #1*. This document, which became official policy, "proposed a truly radical departure from earlier practices." Among other recommendations, the authors proposed restoring extirpated species to parks, restoring seriously altered habitats, and spoke of the need to expand boundaries to include year-round habitats for migrating wildlife. Unfortunately, this visionary document was never thoroughly implemented and often given only lip service until eventually superseded by other directives and policies in the 1960s and 1970s.

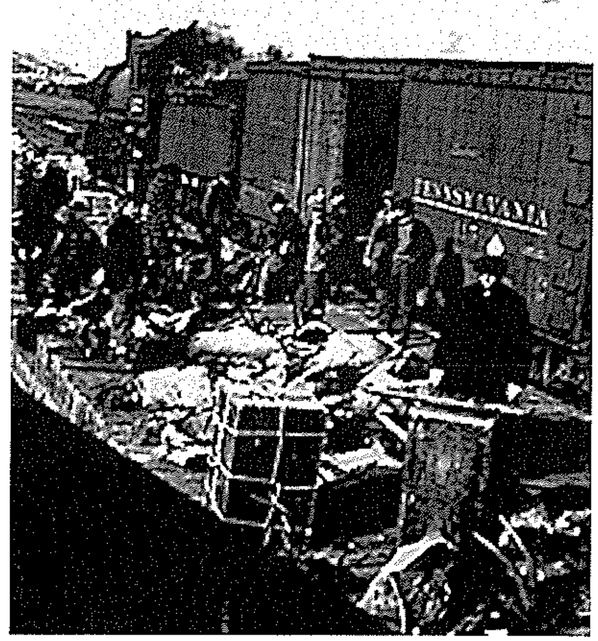
When one looks back at some of the early manipulative management actions of the Park Service (feeding bears, keeping bison on display as in a zoo), it is gratifying to see how far the Park Service has come in its views toward nature, at least as an institution. But at the same time, it's humbling to realize that, in many ways, we still have a long way to go. The current philosophy on fishing in national parks, for instance, is not substantially different from the early 1930s. Sellars notes, "So deeply entrenched was the tradition of fishing national park rivers and lakes that the wildlife biologists themselves seemed ambivalent and did not seek to discontinue this activity," even though David H. Madsen, a Bureau of Fisheries biologist detailed to the NPS, observed that the Park Service's fish management was "entirely inconsistent" with other wildlife policies. Today, the recreational fishing tradition continues to be deeply entrenched, and we see exotic species being protected in national parks for the amusement of visitors, a strong departure from the more ecologically oriented management that, fortunately, is becoming the norm.

As might be expected in any history of the National Park Service, Yellowstone figures prominently in the book. The role of fire, the grizzly bear management controversy, the development of tourist facilities, and the extirpation and restoration of wolves are all discussed extensively and accurately. As might be expected, early views on predator control and then the long-standing advocacy many scientists for the artificial culling of ungulates appears again and again, giving us a thorough historic background leading up to the natural regulation policies of today. Early Yellowstone history makes up a good share of the first two chapters, due to the park being one of the few in existence during its first 50 years and because of its notoriety as the first national park. Many new policies were tried out in Yellowstone in the early years of the Service due to Horace Albright's strong influence on the Directorate during his superintendency here.

Perhaps a better title for the book would have been, "Preserving Nature *Through Science* in the National Parks." There is no question that management decisions should always have scientific backing and justification. It is also clear that the NPS has often ignored or even suppressed ecological principles in carrying out park management. Yet, somehow our natural national parks have been preserved remarkably well over a substantial period of time, considering some of the enormous pressure for one kind of development or another. Sellars concentrates almost entirely on science, or lack thereof, affecting management decisions that leave us where we are today. He seems to regard interpretation and law enforcement as purely visitor service activities, and not resource management or nature preservation activities. Left out of most of his discussions are protection and interpretive rangers who, from the start of the Service, have directly protected and preserved nature in the parks.



Park rangers with predator hides during National Park Service predator control era in the 1920s. Photo NPS archives.



Hunters loading elk at the Gardiner (Montana) depot in 1919. Once they were protected by Yellowstone National Park game laws, migrating members of the northern Yellowstone elk herd supported an important sport hunt in southeastern Montana. Photos NPS archives.

Protection rangers are included mainly in discussions of how the NPS culture evolved, and interpretive rangers are almost ignored completely, other than some early references to the naturalists in explaining organizational structure. The role of the naturalist is finally touched on in the last chapter, except it is implied that, in general, NPS interpretive programs have little substance, aren't science based, and mainly impart only aesthetic appreciation, thereby indirectly helping to attain preservation. Yet from early on, interpretive rangers' programs in the parks were usually science based, and often included a park preservation message; certainly that is strongly the case today. Likewise, both ranger divisions have always directly protected and preserved park resources on a daily basis. Although these activities aren't as obvious in the historical record as policy decisions, high-level memos, or director's orders, they probably had a substantial affect on management decisions and definitely swayed public opinion about the parks.

In spite of that one shortcoming, I found the book to be fascinating, as I think it would be for any student of the NPS or American conservation history. It is a valuable volume to have on the shelves of every park in the system, regardless of the type of park—for it imparts an understanding of NPS culture, how it evolved over time, and how important that culture and tradition was and still is in decision making. Sellars shows us how public opinion and institutional tradition are incredibly powerful forces which are very hard to change, even in the face of clear scientific evidence. Toward the end of the book he states, "the National Park Service remains a house divided—pressured from within and without to become a more scientifically informed and ecologically aware manager of public lands, yet remaining profoundly loyal to its traditions." The Service has been slowly but steadily improving its management practices through the use of scientific knowledge and education of the public. What will the priorities of the next century be? The Park Service has done a wonderful job of providing commercial services for its visitors, and "selling" the national park idea to the public. Let's hope the Service will now continue to develop the foresight, dedication to scientific principles, and the strong will needed to preserve nature in (and around) the national parks.

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Lynx to be Listed Under Endangered Species Act

As part of a proposed settlement over a lawsuit filed by the Defenders of Wildlife and 14 other organizations, the U.S. Fish and Wildlife Service (USFWS) recently proposed to take action to list the Canada lynx (*Lynx canadensis*) under the Endangered Species Act. A series of legal actions regarding the lynx have been pending since 1991. The USFWS determined that lynx were historically resident in 16 of the contiguous United States, and that they currently occur at low levels in Montana, Washington, and Maine. They are rare in Idaho, Wyoming, Oregon, Michigan, Minnesota, Wisconsin, Utah, Colorado, Vermont, and New Hampshire; the USFWS believes they have been extirpated from New York, Pennsylvania, and Massachusetts.

Publication of a proposed rule in the Federal Register is planned for the summer of 1998, followed by a public comment period to actively solicit new information about the status of lynx and related threats, and ongoing conservation activities. Lynx are believed to have ranged historically in Yellowstone and may still remain, although reliable information on their past and present status is scant.

Experts Discuss New Zealand Mud Snails

On March 16, 1998, Yellowstone sponsored a mini-conference of visiting experts on the exotic New Zealand mud snail (*Potamopyrgus antipodarium*). The mud snail, first documented in North America in Idaho's Middle Snake River in 1987, is of growing interest to biologists and managers. This invader can be rapidly distributed by floating algae, boats, fish, anglers, birds, pump irrigation, and other means. Dr. Peter Bowler (University of California, Irvine) and Dr. Terrance Frest (Deixis consultants, Seattle) found it in the Madison River in and outside Yellowstone in 1995. Subsequent surveys also discovered the snails in the Firehole and Gibbon rivers and in Nez Perce Creek. Dr. Michael Gangloff (Montana State Univiversity) and others are continuing to study the distribution and effects of the mud snails in the ecosystem. Biologists express concern that mud snails could be outcompeting native gastropods for food and habitat, such as moist refugia during water-level fluctuations. The experts shared their views on ecological impacts of the invader, research needs, and potential ways to control its spread in the park.

Researchers to Study Cougar-Wolf Interactions

The Hornocker Wildlife Institute (HWI) of Moscow, Idaho, recently received a permit to continue studying cougars in northern Yellowstone National Park. Researchers from HWI initiated the first study of the park's big cats in 1987 (see volumes 2(3) and 2(4) of *Yellowstone Science*) and now plan a multi-year investigation of the interactions between lions and wolves and their combined effects on ungulate populations. From 1987 to 1996 HWI scientists captured, radiocollared, and monitored 84 cougars and documented their home ranges, social behavior, and predatory habits. The primary goals of the new study are to assess the effects of wolves on the cougar population and to assess cougar-prey relationships by comparing new data with information collected on cougars prior to wolf restoration.

Anglers Satisfied with Fishing Experience

Since 1973, Yellowstone has used a Volunteer Angler Report (VAR) system to annually monitor parkwide angling in Yellowstone. Data is obtained from a VAR card attached to each fishing permit sold to a park visitor. Nearly 2.9 million people visited Yellowstone in 1997. The park issued approximately 67,900 fishing permits in 1997, and anglers returned 3,666 usable VAR cards (5.4% of those issued). Parkwide angler use (angler fishing days) and effort (hours spent fishing) were 240,141 angler days and 587,781 hours, respectively. Although angler use in terms of days fished increased 3% over levels seen in 1996, the amount of fishing effort per day decreased from 631,700 hours in 1996. Anglers landed 558,121 fish and creeled about 32,120 in 1997, releasing approximately 94% of all fish landed. The average angler fished 2.5 days, 1.4 different waters/day, and 2.5 hours/day. Mean annual landing creel rates were 0.95 and 0.05 fish/hour, respectively. Nearly 78% of single-day angles landed one or more fish. An estimated 83% of park anglers reported being satisfied with their fishing experience.

El Niño Makes for Dry Snow Year

Phil Farnes of Snowcap Hydrology in Bozeman, Montana graciously provided the following report; What a difference a year can make! In 1997, snows came early and heavy in the Yellowstone area. Most measurements of snow-water equivalent (SWE) were at or near record levels. In contrast, during 1998—considered to be an El Niño year—the SWE was well below average on January 1, although it was nearly to average levels in the higher elevations by February 1. In all areas, it took until at least March 1 before SWE approached the levels recorded on January 1, 1997 (see Table at right). Additional information on snowpack can be obtained from the Natural Resources and the Conservation Service (NRCS) Snow Survey offices in Bozeman, Montana or in Casper, Wyoming.

SITE NAME	ELEV(ft)	JANUARY 1 1997	JANUARY 1 1998	JANUARY 1 AVG.	FEBRUARY 1 1997	FEBRUARY 1 1998	FEBRUARY 1 AVG.	MARCH 1 1997	MARCH 1 1998	MARCH 1 AVG.
Aster Creek	7,750	28.2	7.9	12.8	38.4	20.2	20.0	44.0	24.1	25.3
Black Bear*	7,950	38.6	12.7	15.6	48.9	26.5	24.5	51.2	31.4	31.7
Canyon*	8,090	14.4	4.5	5.3	19.0	9.5	8.3	21.4	10.7	10.7
Crevice Mtn.	8,400	-	-	-	-	9.5	7.0	14.5	9.9	9.0
Fisher Creek*	9,100	34.2	12.9	15.6	43.8	23.1	24.2	49.2	25.6	30.3
Grassy Lake*	7,270	26.8	12.0	14.3	37.2	23.9	23.0	40.4	26.7	29.6
Lake Camp	7,780	9.9	3.0	3.8	14.4	6.1	6.1	16.4	7.2	8.2
Lewis Lake Divide*	7,850	31.3	10.2	13.8	11.9	21.0	22.8	48.0	24.0	29.5
Lupine Creek	7,380	9.6	2.2	4.3	11.4	5.6	6.9	14.0	7.8	8.9
Madison Plateau*	7,750	24.1	6.5	10.1	31.9	13.9	16.1	36.4	17.0	20.6
Norris Basin	7,500	9.8	2.2	5.0	11.9	5.2	8.0	12.3	5.4	9.9
NE Entrance*	7,350	6.9	2.3	4.0	9.3	5.4	6.4	11.3	6.2	8.1
Old Faithful	7,400	15.4	3.4	6.4	19.4	8.9	10.8	23.9	11.0	13.7
Parker Peak*	9,400	18.4	8.2	10.6	24.5	13.7	14.3	28.0	14.9	18.0
Snake River Station	6,920	16.2	6.3	8.8	22.0	14.1	14.0	28.6	15.8	18.2
Sylvan Lake*	8,420	17.3	7.1	10.8	24.8	11.9	14.9	28.0	13.6	18.5
Sylvan Road*	7,120	11.5	3.7	5.8	16.5	7.8	8.5	18.7	8.4	11.2
Thumb Divide*	7,980	18.9	5.1	7.2	26.0	11.2	11.4	28.6	13.1	14.3
Twenty-One Mile	7,150	14.0	4.2	7.3	20.6	9.4	11.7	23.7	11.2	14.9
Two Ocean*	9,240	26.4	11.0	12.6	35.7	20.1	18.3	39.1	22.4	22.2
West Yellowstone	6,700	11.4	2.6	4.8	12.5	6.4	7.8	15.6	8.7	10.3
Whiskey Creek*	6,800	15.0	4.1	7.0	19.7	9.5	11.2	22.3	11.7	14.5
White Mill*	8,700	23.3	10.4	11.4	30.1	17.5	16.8	33.6	19.1	21.2
Younts Peak*	8,350	15.0	6.6	8.9	18.5	11.6	12.2	20.6	12.5	14.8
Parkwide % Average		212	72		183	95		162	87	

Note: SWE's are in inches. Average is for 30-year period 1961 to 1990.
* Date from snow pillows at automated SNOTEL sites. Other measurements are from snow cources where SWE is measured manually near the first of the month.
Compiled from data collected by the National Park Service, U.S. Forest Service, Bureau of Reclamation and Natural Resources and the Conservation Service.